EXPERIMENTS ON LOSSES IN THE STEAM CYLINDER.

HERR ESCHER, of Zurich, has been experimenting on some obscure points as to steam engine economy. The results at which he has arrived will be found valuable by the numerous engineers who are interested in this question. Between the amount of feed-water expended and the steam used, as calculated simply from the volume admitted up to the point of cut-off and the pressure, there is always in practice an important difference, varying from 30 to 60 per cent., or even more. This difference is due to several causes: (1) There is a loss of steam through the want of perfect steam-tightness in the piston and valves; (2) the cylinder at the time of cut-off contains, not pure steam, but steam mixed with a proportion of water, which water is partly carried over mechanically from the boiler, partly formed by condensation in the steam pipe and valve chest; (3) a further quantity of steam is condensed on the walls of the cylinder itself. Hitherto practical experiments have only extended to the second of these conditions, viz., the proportion of water contained by the steam at the moment of cut-off; and even these are not altogether satisfactory. On the other points little or nothing seems to be known; the loss through the valves is generally considered insignificant, and the large total loss is ascribed by one party to condensation in the cylinder, and by the other to leakage past the piston. Herr Escher resolved therefore to make experiments on these two causes of loss separately, and though his results were not completely satisfactory, they are important at least as indicating the line to be followed, and the importance of the losses considered.

The results of the experiments are given in the following tables:—

Pressure (absolute). Kg. per sq. cm.	No. of admissions per min. n	Duration of admission (t). Seconds.	Water obtained at each admission. Grammes.	Weight of steam filling chamber. Grammes.	Steam condensed on walls at each admission (g). Grammes.
	(1) *Without either jacket or air pump.*				
$p = 3{\cdot}41$	30·0	0·605	4·976	0·150	4·826
	59·6	0·304	3·310	0·152	3·158
	90·5	0·200	2·439	0·154	2·285
	119·9	0·151	1·969	0·155	1·814
$p = 4{\cdot}26$	30·2	0·601	5·451	0·201	5·250
	59·9	0·303	3·797	0·205	3·592
	89·2	0·203	2·930	0·207	2·723
	120·8	0·150	0·336	0·209	2·127
$p = 5{\cdot}18$	30·9	0·587	5·591	0·257	5·334
	60·2	0·301	4·067	0·261	3·806
	89·9	0·202	3·074	0·263	2·811
	119·7	0·152	2·719	0·265	2·454
	(2) *Without jacket, but with air pump.*				
$p = 3{\cdot}41$	29·75	0·610	5·061	0·216	4·845
	59·4	0·305	3·578	0·218	3·360
	90·75	0·200	2·551	0·220	2·331
	120·2	0·151	2·068	0·222	1·846
$p = 4{\cdot}26$	30·1	0·610	5·500	0·267	5·233
	60·0	0·302	4·017	0·270	3·747
	90·2	0·201	3·048	0·273	2·775
	120·1	0·151	2·449	0·275	2·174
$p = 5{\cdot}18$	29·9	0·607	5·622	0·324	5·298
	59·8	0·303	4·223	0·327	3·896
	90·8	0·200	3·126	0·330	2·796
	118·2	0·153	2·798	0·332	2·466
	(3) *With jacket, but without air pump.*				
$p = 3{\cdot}41$	30·1	0·603	1·124	0·157	0·961
	59·8	0·303	0·838	0·158	0·680
	89·4	0·203	0·700	0·158	0·542
	120·6	0·150	0·575	0·158	0·417
$p = 4{\cdot}26$	30·2	0·601	1·281	0·211	1·070
	59·8	0·303	0·912	0·212	0·700
	90·2	0·201	0·812	0·212	0·600
	119·8	0·151	0·689	0·213	0·476
$p = 5{\cdot}18$	30·0	0·605	1·570	0·268	1·302
	59·9	0·303	1·145	0·269	0·876
	90·0	0·202	0·991	0·269	0·722
	120·0	0·151	0·841	0·270	0·571
	(4) *With both jacket and air pump.*				
$p = 3{\cdot}41$	30·0	0·605	1·129	0·223	0·906
	61·0	0·297	0·899	0·224	0·675
	90·0	0·202	0·767	0·224	0·543
	119·7	0·152	0·643	0·224	0·419
$p = 4{\cdot}26$	30·0	0·605	1·356	0·276	1·080
	59·6	0·304	1·070	0·277	0·793
	89·8	0·202	0·876	0·288	0·588
	119·9	0·151	0·747	0·288	0·459
$p = 5{\cdot}18$	30·2	0·601	1·557	0·333	1·224
	59·2	0·306	1·273	0·334	0·939
	90·5	0·200	1·042	0·335	0·707
	120·7	0·153	0·930	0·335	0·595

Condensation in the Cylinder during Admission.—The determination of this amount in the steam engine itself is probably impossible, but it is easily accomplished by the aid of special apparatus. If a cast iron chamber is opened by valve gear alternately to a boiler and to a cold chamber, there will be alternately a condensation and evaporation on the walls of this chamber exactly as in a steam cylinder. By comparing the amount of water obtained from the cold chamber with the volume of the vessel, and the weight of pure saturated steam corresponding to this volume, the steam condensed in the vessel is at once determined. By moving the valve gear quicker or slower the time of admission is altered, and its influence can be investigated. In the author's apparatus the vessel consisted of two round cast iron plates, with a ring of copper wire laid between them, and made steam tight. Outside these were fixed two other plates, bolted to them, and leaving flat steam spaces between, to form a jacket. The plates were protected on the outside by slag-wool. The valve gear was worked by two excentrics on a pulley shaft actuating two valves placed at the top and bottom of the casing. The valves were accurately finished, so as to be sure that there was no leakage through them, and the valve chests were enveloped in cotton waste. The content of the apparatus between the two valves was 129 cubic centimetres, and the total internal surface was 1250 square centimetres. The duration of admittance of steam was found to be 0·302, and that of the exhaust 0·373 of the time of a half revolution of the shaft. The number of revolutions was measured by a counter. The apparatus was fixed close to the boiler, and connected with it by a ½in. gas-pipe enveloped in waste. The exhaust led to a coil of lead pipe which was cooled by the condensing water. At the bottom of the coil the condensed steam was either taken direct into a large glass bottle, or first drawn through a small hand pump serving as air pump. The jacket formed by the outer plates was similarly connected with the boiler, and the exit of the steam condensed in it was regulated by a cock. In order to measure this steam, a glass tube was first inserted in the outlet above the cock, and the cock so regulated that the condensed water was always visible in the glass tube; by this means no loss of steam was possible. After long experiments the author was obliged to abandon the determination of the loss of steam in the jacket. He soon observed that the quantities of water taken from the chamber and from the jacket showed great variations in the opposite directions. The increase of the former and decrease of the latter were the greatest just after the boiler had been fed by the injector, which sucked in a great deal of air. To preserve the pressure uniform this feeding took place in small quantities and at short intervals. He therefore concluded that the variations were due to air collected in the jacket, and therefore kept the cock so far open that there was always a slight leakage of steam. From henceforward the results showed a satisfactory uniformity. This circumstance explains the fact that the jacket of a steam engine is always more effective when the whole volume of steam is passed through it, than when it is only fed by a branch pipe.

(1) The first deduction from these tables is that the amount of condensation increases with the duration of admission, and with the pressure.

(2) The condensation is much less in the experiments with the heated jacket, and this saving is far from being neutralised by the expenditure in the jacket. The greatest amount thus expended, as observed in the glass pipes, was 21 Grammes per minute. This gives the following as the total loss per admission:—

$p = 5{\cdot}18.$	With jacket.	Without jacket.
$n = 30$	2·002 g	5·334 g
60	1·226 g	3·806 g
90	0·955 g	2·811 g
120	0·746 g	2·454 g

(3) The results are practically not altered by the employment of the air-pump. The water per admission is slightly greater with the air-pump, but the reason is that the weight of steam left in the chamber is less, therefore more must enter at the next admission. Practically we may say that the condensation with or without the air pump is the same. The following empirical formulæ between the three quantities g, p, t—as given in the headings of the table—represent the results of the experiments:—

(1) Without jacket $g = 4{\cdot}07 \times p^{0{\cdot}413} \times t^{0{\cdot}64}$

(2) With jacket $g = 0{\cdot}673 \times p^{0{\cdot}553} \times t^{0{\cdot}58}$

If we take the condensation per square metres and assume $t = 0{\cdot}1, p = 6$, we obtain 15·633 grammes as the condensation per admission. If this were to go on for an hour, it would give a total condensation of 563 kilogs., with a difference of temperature of 58 deg. Cent. at most. But a surface condenser with a difference of temperature of 70 deg. condenses about 100 kilogs. only per square metre per hour. Hence we see the fallacy of comparing the condensation in a surface condenser with that on the cylinder walls, as is sometimes done to show the insignificance of the latter. The conditions are quite different. In the former the heat passes straight through a thin metal sheet into a thick layer of water, which is a non-conductor; in the latter there is a continual change in the direction of the heat. The layer of condensed moisture is removed again during the next admission, partly evaporated, partly brushed off mechanically, so that the newly admitted steam comes at once in direct contact with the walls. The condensation must therefore be much greater than in the other case. To show the completeness with which the condensed moisture is removed during admission, the working of the apparatus was suddenly stopped at the moment between closing the exhaust and the next admission, the inlet and outlet pipes were taken off, and glass tubes, filled with chloride of calcium, put in their places. By means of an aspirator, a slow stream of air, which was dried at its entrance by the chloride of calcium, was passed through the apparatus. The water left in the apparatus thus became deposited in the chloride of calcium at the outlet. The amount of this water per square metre of surface was found to be as follows:—

(1) Without jacket, 5·55 g (mean of seven experiments).

(2) With jacket, 1·62 g (mean of four experiments).

These quantities, it will be seen, are exceedingly small.

Experiments on Loss through Piston.—The loss through want of tightness in the piston is of course influenced greatly by the special conditions of each particular case, and the experiments described can only be useful as a guide. The engine used was a horizontal condensing engine, 300 mm. diameter, 750 mm. stroke, with Meyer valve gear, and with jacket fed by a branch pipe. The piston packing consisted of two cut cast iron rings outside a wrought iron expansion ring. For the experiments the machine was made single-acting by removing the gear, &c., from the hinder end of the cylinder. A small valve opening outwards was fixed at this end, connected with a coil of cold pipe, from the end of which the condensed steam which had leaked past the piston fell into a glass flask. During the forward stroke there was, of course, a vacuum behind the piston, but towards the end of the back stroke the pressure rose, and forced the steam which had leaked past the piston through the valve and into the cold pipe. The conditions were thus very closely similar to those of an ordinary condensing engine. The valve faces were carefully got up to reduce any loss in that direction. To find the amount of the clearance spaces, the piston was stopped at the dead point, and the space then filled up with water. It was found, however, that the piston was by no means tight, and the amount of leakage had to be measured to determine the clearance space, which was found to be 1259 cubic centimetres, or 2½ per cent. of the volume swept through by the piston. The surface corresponding to this was 2635 square centimetres. The experiments were made when the engine was running under a brake not too tightly put on, and the results were as follows:—

No. of Expt.	With or without jacket.	Boiler pressure (absolute) kg. per sq. cm.	Revs. per min.	Cut-off.	Mean pressure on piston (vac. absolute) kg. per sq. cm.	Loss past piston (single acting).		
						Per min.	Per stroke.	Per cent. of feed-water.
1	Without	5·29	66·3	0·16	2·31	111·45	1·681	3·1
2	,,	5·31	64·77	0·09	1·65	118·66	1·844	3·96
3	,,	5·50	67·3	0·10	2·34	118·60	1·762	3·3
4	With	5·49	72·2	0·10	2·345	76·11	1·054	

These figures show that even in this particular the jacket has a marked influence on the loss of steam. In experiments 1—3 the amounts of the feed-water and condensing water were observed. With No. 4 this could not be managed. Taking only experiment No. 2 the particulars are as follows:—

Boiler pressure	5·31 kg. per sq. cm.
Cylinder pressure...	5·1 ditto.
Cut-off	0·09
Work per stroke indicated...	660·45 kgmetres.
Feed water	46·45 gr.
Loss past piston	1·84 gr.
Condensing water	1178·85 gr.
Heating of do. (19·8 deg. to 37·5 deg.)	17·7 deg.

If we neglect the external cooling of the cylinder, and assume that the steam leaking past the piston goes away at 100 deg., the water in the steam at entrance into the cylinder can be calculated. It amounts in this case to 22 per cent., which, however, is somewhat too large because the external cooling has been neglected. On comparing the actual expenditure of feed-water with the steam which passed through the apparatus, and with the amount condensed on the walls and leaking through the piston, as determined by the experiments, there appears a large deficiency—too large to be fully accounted for, either by water contained in the steam when admitted, or by leakage through the valves. It is probable, therefore, that the condensation inside an actual cylinder is much larger than appeared in the experimental apparatus; and as this already appears to be so considerable, the experiments, though not thoroughly satisfactory in themselves, are sufficient to show the great importance attaching to the question.

THE FOUNDATIONS OF MECHANICS.

By WALTER R. BROWNE, M.A.

No. VI.

85. *Parallelogram of Velocities.*—From the fact mentioned in the last section, that in the proof of the Parallelogram of Forces the forces have been represented by the velocities generated by them, it follows at once that the velocity of a centre at any moment may be resolved, in thought, into two component velocities, on exactly the same conditions as a force may be resolved—viz., that the lines representing the components form the two sides of a parallelogram, of which the diagonal represents the actual velocity. This proposition is usually demonstrated independently as the Parallelogram of Velocities, and is often stated in the converse form, namely, that two velocities, existing at the same time, may be compounded into a resultant velocity. This, however, is a confusion of ideas. It is quite right to regard a body as under the action of two forces at the same time, and to compound their effects, because such forces are separate realities; but the velocity of a body at any instant must be in one definite direction, and of one definite amount, and it is only in thought that it is possible to analyse it into two velocities tending in two different directions, and capable of being studied independently.

86. *Moving Forces—Energy—Work.*—We have now to consider the principles to be followed in dealing with moving forces. The fundamental problem in this department may be stated as follows:—*How are we to measure the total effect of a given force, when it has acted for a given time on a centre, or a group of centres of given mass, which is in motion during the action?*

87. The answer to this question may be stated at once. It is that the effect is measured, with regard to the force—which for the present we may consider to be constant—by the product of the force and of the distance moved through by the centre or body, in the direction of the force, during the action. And this product is called the energy exerted by the force. Again, with regard to the body moved, the effect is measured, if the body start from rest, by the product, at the end of the action, of the mass and of half the square of the velocity in the direction of the force; or by the difference between this product and the similar product taken at the beginning of the action, if the body has already a velocity in that direction when the action commences. This product is called the *vis viva*, or the kinetic energy, or the actual energy, or the energy of motion, of the body; and the effect of the force is therefore measured by the change in this quantity, whichever name be used for it, during the action. Throughout this paragraph it is assumed that there is no force acting on the body in the opposite direction.

88. These principles are laid down in all text-books, but usually without any explanation of the reason why the energy exerted—*i.e.*, the product of the force and the distance—is the proper measure of the effect of the force. Nor does it at first sight seem clear why the element of time should be altogether absent from the measure of the effect, or why this measure, referred to the body, should be in terms of the square of the velocity, and not of the velocity simply.

89. To elucidate this, let us suppose that the force, instead of being continuous throughout the motion, acts discontinuously at certain equal small intervals of space ds, so that, at the beginning of each of these intervals, there is an instantaneous action which generates in the body exactly the same velocity as is really generated during that interval by the continuous force. Let the number of these intervals in any space s be n, so that $s = n\,ds$. Then the total effect on the body while traversing the space s will, by the second law of motion, be the sum of the n effects due to the action of the n equal impulses at the beginning of the n intervals. It is evident, therefore, that, so long as the strength of the impulses remains the same, the total effect will vary as n, or, since $s = n\,ds$, and ds is supposed always the same, the total effect will vary as s. Again, if the number of the impulses remains the same, the effect will of course vary with the strength of each impulse; in other words, with the force. Hence, by the ordinary principle of variation, if both the spaces and the forces be different, the effect will vary as their product. But by considering the length of each interval ds as indefinitely small, and therefore the number n as indefinitely great, we may make the assumed circumstances approach indefinitely near to those of a constant force acting continuously over the same space; and hence we may say that the effect of such a force will vary as the product of the force itself, however measured, and the distance through which it acts. This, as already stated, is called the energy exerted by the force. It does not contain the element of time, because neither the number of impulses nor the strength of each impulse are in any way affected by the velocity with which the body passes over the successive intervals ds; in other words, by the time which it occupies in describing the whole distance s.

90. We have thus shown that if F be the moving force of a given centre A, and s the space through which it acts on any other body or centre B, its effect will be properly measured by the product F s. This assumes that F is constant. If F vary with the distance, as will always be true in nature, then the same holds for each indefinitely small element of space ds—*i.e.*, the effect of the force, while the moving centre B traverses this element, is measured by F ds. To find the effect for any finite space s, we have only to integrate F ds from O to s.

91. Let us now express the same product in terms of mass and velocity. Since the force is a moving force, it is properly expressed (Art. 58) by M f, or (Art. 70) by $M\frac{d^2 s}{dt^2}$. Also, since ds is indefinitely small, we may consider that the velocity of B, while it traverses ds is constant; hence we may write (Art. 70),

$$ds = v\,dt = \frac{ds}{dt}\,dt.$$

Hence, for F ds we may write—

$$M\,\frac{d^2 s}{dt^2}\,\frac{ds}{dt}\,dt\text{; or, }M v\,\frac{dv}{dt}\,dt.$$

This we have to integrate between the limits O and t, where t is the value of the time when the space s has been described. The value of this integral is well known to be $\frac{1}{2}M(v^2 - v_0{}^2)$, where v_0 is the value of the velocity when $t = O$. Hence it appears that the effect of the force may also be represented by $\frac{1}{2}M(v^2 - v_0{}^2)$—that is, by the change in the kinetic energy, *vis viva*, or whatever other name we apply to that quantity.

92. The two modes of representing the effect of a continuous force—by energy exerted and by the change in the *vis viva*—are thus established. The resolution of the single resultant force, so as to extend the principle to three dimensions, and thus make it general, may easily be accomplished, as shown in any of the ordinary text-books.

93. Hitherto I have assumed that there is no force acting on the moving centre B in the opposite direction to its motion towards the fixed centre A. This is what would be true if A and B were the only centres in the universe. In nature such a case, of course, cannot occur. The number of centres in the universe is incalculable, and, by my definition of matter, these all act upon both A and B. There are cases, however, where the action of these extraneous centres, owing to their distance or other causes, is insignificant when compared with the direct action between A and B, and may for many purposes be neglected. One such case is that of a body falling to the earth in vacuo. Another is that of a planet revolving round the sun, where the small disturbances due to other planets may, for many purposes, be neglected. In these cases the effects are represented with sufficient exactness by the expressions indicated above. But I must now go on to consider what modifications are introduced by the presence of other forces.

94. Let me as usual take the simplest case, and assume that, in addition to the fixed centre A and the moving centre B, there is a third centre C placed in the prolongation of the line A B, on the other side of B, and therefore acting upon B in the opposite direction to the action of A.* For further simplicity we shall assume (1) that C and A have no mutual action; (2) that B is initially at rest; (3) that C as well as A is fixed; (4) that the forces with which B and C act on A are constant, or only vary by amounts that may be neglected. We will consider hereafter how far these assumptions can be realised in the universe, and how far they effect the conclusions.

95. Let P and Q be the forces, measured dynamically, with which A and C respectively act upon B; and let P be greater than Q. Then, by the second law of motion (Art. 50), each of these forces will produce its full effect exactly as if the other was not present, and the net effect upon B will be simply the difference between these opposite effects. Let s be the distance through which B has moved towards A at the end of a given time. Then the effect of A will be measured just as before by the product P s. For as in our former proof (Art. 89), we may imagine the action of A divided into impulses, which act at successive points in space separated by small intervals, but which are independent of the time occupied in describing the intervals between one point and another—as they must be, because, by our definition of matter, the forces are not functions of time. Each of these impulses will produce its full effect, by the second law, independently of the action of C, and, as before, the total effect will vary jointly as the number and strength of the impulses, and will, therefore, be represented by P s. Let us now make a similar assumption with regard to the action of C, namely, that it is divided into impulses acting at the same points in space as those of A. Each of these impulses will produce its effect, but this effect will be neutralised, as regards B, by the opposite impulse due to A; and the net impulse actually given to B will be the difference between the impulses due to A and C respectively. Since these impulses all vary as the forces, *i.e.*, as P and Q respectively, it follows that the net effect on B will be exactly the same as if it had been acted on by a single force P – Q. Taking this for the value of the force, our former investigation (Art. 89), will hold again; the energy exerted on P will be represented by (P – Q)s, as regards the force, and as regards the body B it will be represented by the *vis viva*, or Bv^2, where B is taken for half of B's mass, and v its velocity after describing the space s.

86. The facts regarding the real effect on a body of two opposing forces have now been set forth; it still remains to consider the names by which the different quantities involved are to be designated. It will be found that names are required for the following:—(1) The force P with which A acts on B, and which actually causes the motion of B in the direction B A; (2) the force Q with which C acts on B, which tends to cause motion of B in the direction B C, and which actually retards its motion in the direction B A; (3) the difference between these forces, or P – Q, which is the net force acting upon B, and causing its motion; (4) the total effect of A, which, as we have seen, is represented by P s; (5) the total effect of C, which is represented by – Q s; (6) the net effect of the action of A and C together upon B, which is represented either by (P — Q)s, or by B v^2. To some of these we have already assigned names provisionally, but it will be well to go through them all.

87. With regard to the first three, I shall have no difficulty in adopting the nomenclature of Rankine, which appears to be the only one definitely proposed. We shall thus give to P the name of the effort, to Q that of the resistance, and to P – Q that of the unbalanced effort. The first name is not quite free from objection, because in common parlance we speak of effort rather when we do not succeed in overcoming a resistance than when we do; but it may be allowed to pass in the absence of any competitor. Again, No. 4, or the total effect of A, is everywhere known as the energy exerted by A. So far all is simple. When we come to No. 5, or the total effect of C, the case is different. We are here face to face with a variation in nomenclature on the part of our highest authorities, which has not been generally noticed, and which is at least liable to lead to confusion.* On the one hand, Rankine gives to this effect, or – Qs, the name of the Work done. According to him, work is done only when Resistance is overcome, and when, therefore, there is a third body acting, such as C, which tends to move B in the opposite direction to its actual motion. On the other hand, Thomson and Tait, Clausius, and most of our more recent writers on dynamics, give to the expression work done a much wider signification. With them it is in fact equivalent to the energy exerted, or P s; being the same thing, but looked at from the point of view of the body acted upon, rather than the body acting. The name they apply to – Q s is not always well determined; but we shall assume it to be the Potential Energy imparted to B. The reason of this name we shall see hereafter. To No. 6, represented by (P – Q) s, or B v^2, they would assign the name of the Kinetic Energy imparted, while Rankine would call it the Actual Energy; both these names being intended to supersede the older term of *vis viva*, which we have hitherto provisionally used.

88. It is necessary to prove the fact of this variation in nomenclature by quoting and illustrating the exact words employed by the authors referred to, and I shall then comment briefly upon it.

89. In order to set forth Rankine's views, it will be best to give the following extract from his "Applied Mechanics," 1st edition, Art. 513:—"Work consists in moving against resistance. The work is said to be *performed*, and the resistance *overcome*. Work is measured by the product of the resistance into the distance through which its point of application is moved. The unit of work commonly used in Britain is a resistance of one pound overcome through a distance of one foot, and is called a foot-pound. Energy means capacity for performing work. The energy of an effort, or potential energy, is measured by the product of the effort into the distance through which its point of application is capable of being moved. The unit of energy is the same with the unit of work. When the point of application of an effort has been moved through a given distance, energy is said to have been exerted to an amount expressed by the product of the effort into the distance through which its point of application has been moved."

90. It may be argued that in these definitions Rankine intended to include the resistance—allowing for the moment the use of the term in that connection—of inertia, which would exist even where there are only two bodies concerned. That this was not the case is made abundantly clear as follows:—

91—(*a*) Rankine's definition of resistance (Art. 511) is as follows:—"A direct force is further distinguished according as it acts with or against the motion of the point . . . by the name of effort, or of resistance, as the case may be." Now inertia certainly cannot be an effort, therefore it cannot be a resistance.

92—(*b*) If the inertia be added to the resistance, and the same considered equal to the effort, then energy exerted and work done are always equal, being, in fact, opposite views of the same thing. Of this Rankine gives no hint.

93—(*c*) Work is said to be measured by the resistance. But we have no measure of inertia, excepting the distance through which it is overcome by a given effort; therefore it must be the effort and not the resistance by which the work must be measured, if inertia is included in the latter.

94—(*d*) In Art. 549 (p. 499) Rankine takes the case of "a moving body acted upon by an effort P and a resistance R, the effort being the greater, so that there is an unbalanced effort P — R;" and he lays down the equation resulting as follows:—

$$\frac{W}{g}(v_2 - v_1) = (P - R)\,\Delta t.$$

It is evident that R does not here indicate the inertia. A yet clearer case is Art. 689, p. 622, on fluctuations of speed, where P and R—effort and resistance—are represented by different lines, and the work performed is measured by the value of R.

95. It remains to state the opposite view. On turning to Thomson and Tait's "Natural Philosophy," vol. i., 1867, Art. 238, p. 176, I find the following definition:—"A force is said to do work if its place of application has a positive component motion in its direction, and the work done by it is measured by the product of its amount into this component motion. Thus, in lifting coals from a pit, the amount of work done is proportional to the weight of the coals lifted; that is, to the force overcome in raising them, and also to the height through which they are raised. The unit for the measurement of work adopted in practice by British engineers is that required to overcome a force equal to the weight of a pound through the space of a foot, and is called a foot-pound."

96. It is obvious that the definition of work in the first paragraph is different from that given by Rankine. On the other hand, it agrees with that of Clausius—"Mechanical Theory of Heat," p. 1—which puts the point as clearly, perhaps, as is possible. Assuming the force to act on a single material point, he proceeds: "If this point . . . travels in the same straight line in which the force tends to move it, then the product of the force and the distance moved through is the mechanical work which the force performs during the motion."

97. The existence of these two modes of defining work done is thus, I believe, put beyond possibility of doubt. It is clearly desirable that one of these modes should be suppressed, and the other definitely adopted, and it remains to decide which should have the preference. Arguing the question *abinitio*, the following reasons, on behalf of retaining Rankine's nomenclature, appear to have much weight.

98 (*a*). It gives a separate short and definite name for all the quantities concerned, especially if the *vis viva* be retained for No. 5; this can hardly be said of the other system.

99 (*b*). Whichever system may be preferred for dynamics, there can be no doubt that Rankine's is the most convenient for applied mechanics. In dynamics the resistances are usually deducted from the efforts at the commencement, and need not be afterwards considered. But in applied mechanics it is absolutely necessary to take account of these resistances. Thus, to vary a little the illustration given in Thomson and Tait's definition, the problem of moving 10 tons of coals is sufficiently stated for the mathematician, as soon as he knows that the coals start from rest, and that an excess of effort over resistance = 1 ton is available for moving them. He can calculate their velocity at the end of a given time equally well, whether they are standing on a level tramway, on which the resistance to traction is 1 cwt., or hanging in a shaft with their full weight of 10 tons. But this makes all the difference to the engineer who has to fix the strength of the rope, and design the engine which shall do the work.

100 (*c*). Rankine's system was used by him throughout his manuals, which are the recognised text books on the various branches of scientific engineering, and are constantly consulted and appealed to accordingly.

101 (*d*). The other set of definitions makes it necessary to regard inertia as constituting a form of resistance. Now, in common parlance we do not say that a stone, for instance, offers in itself any resistance to falling towards the earth; we reserve the term for the forces opposing its motion, such as the resistance of the air. And it seems also more philosophical to make a distinction in phraseology between the case where the motion is influenced by an actual opposing force, and that where it is influenced only by inertia, which is not a force at all, since it cannot cause motion. The use of the term resistance in both cases would seem already to have led to some confusion. Thus Maxwell—"Theory of Heat"—and Goodeve—"Principles of Mechanics"—both define work as being done against resistance, just as Rankine does; and it is only later on, and accidentally as it were, that the reader discovers that inertia is meant to be included as one of the forms of resistance in this definition.

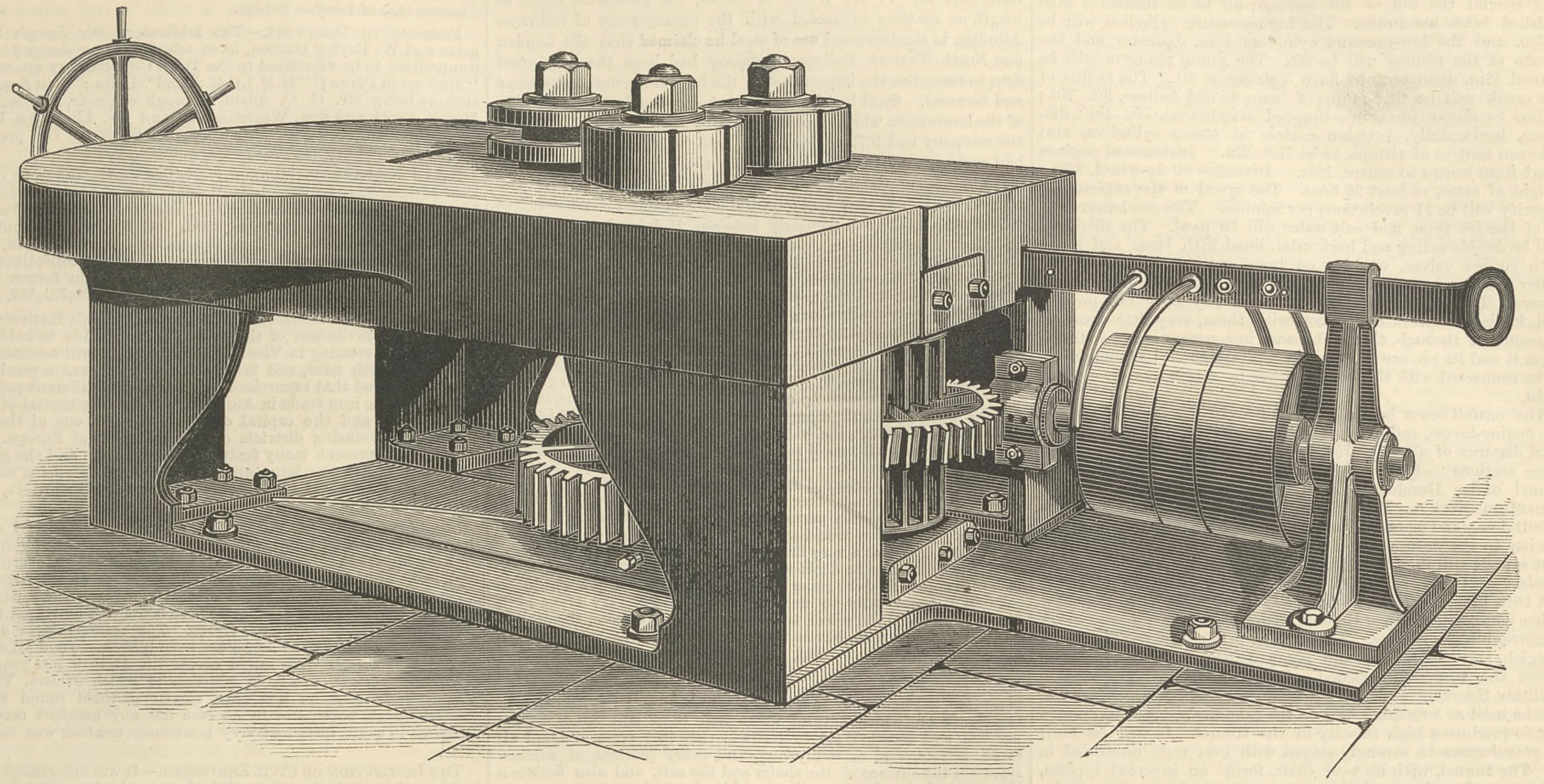
102. In spite of the force of these arguments, it must be conceded, I fear, that the opposite practice to Rankine's has become so general, both here and abroad, that it is not probable it will again be modified. It seemed desirable to bring out as clearly as possible the fact of the variation in question, and to put on record the grounds for wishing that the nomenclature originally introduced by Rankine had been retained. Having done so, I shall not attempt to combat any longer the prevailing fashion, and shall only aim at stating fully and clearly that which it lays down. Returning to the analysis in Art. 87, we shall agree to call P s the Energy exerted, when viewed in reference to the moving force of A, and the Work done, when viewed in reference to the system B and C, on which the effect is produced. It may

* It is supposed throughout that the forces are attractive; if they are repulsive the demonstrations will not be affected, but B's motion will be in the opposite direction.

* I called attention to this variation in a paper read before the Physical Society in March, 1881.

BAR BENDING MACHINE FOR MESSRS. DUBS, GLASGOW.

MESSRS. J. BENNIE AND CO., GLASGOW, ENGINEERS.



be asked why on this system we need retain the word work at all; but, even supposing it possible to banish from the mechanical vocabulary so long-established a term, it is necessary to retain it, in order to keep in view the relations of cause and effect; as will be seen hereafter, when we come to treat of the conservation of energy. Accepting, then, the designation of P s as the total work done, we have yet to fix names for the two parts into which it is divided, represented respectively by $-Q\,s$, and $B\,v^2$. It seems desirable to have distinct appellations for these two parts of the total work done; and the clearest would, in my opinion, be "work of position" and "work of motion respectively;" the former being expended in altering the position of A with respect to another centre, namely, C, while the latter is expended in increasing its velocity. But, bowing as before to general custom, I shall designate them as the potential work, and the kinetic work, since, as we shall shortly see, they are properly correlative to the potential energy and the kinetic energy respectively.

BAR BENDING MACHINE FOR MESSRS. DUBS, GLASGOW.

MESSRS. JAMES BENNIE AND CO., Glasgow, have just designed a machine for bending or curving angle iron, T-iron, or other sections of bar iron or steel. We give, in perspective, an illustration of this machine as recently made for Messrs. Dubs and Co., the well-known locomotive engineers, Glasgow. On a large planed cast iron table there are three rollers, which work on vertical axes. Two of these are driven by powerful worm and spur gear underneath the table; the other roller runs free, and can be moved towards or from the two driving rollers as may be necessary for the section of iron or other metal operated upon. This lateral movement is effected by a hand wheel and screw, which moves a long sliding block carrying the loose roller. This hand wheel is worked preferably from the other end of machine, and thus is quite out of the way of any circling bar. The loose roller shown in drawing is turned to suit either T or angle sections; but this roller, as well as the others, can easily be replaced by any other form to suit any particular sections, by simply unscrewing the nut on top and slipping on another roller. The driving rollers are fluted vertically so as to grip effectually the entering bar. The gearing is driven in the ordinary way by a set of reversing pulleys.

Since this machine was set to work at Messrs. Dubs', it has been kept constantly employed, and we understand it has answered the purpose admirably, and forms a not unimportant addition to the many labour-saving appliances in use by that firm.

BOSTON, U.S., SEWAGE WORKS.

IN criticising some time since the performance of the Ditton pumping engines, we alluded to a statement which has been made to the effect that the engines of the Boston Waterworks, designed by Mr. E. D. Leavitt, jun., required but 16 lb. of water per horse-power per hour.

We publish at page 122 a general elevation of a pair of engines designed by Mr. Leavitt, jun., Boston, for a proposed high-service water supply, lift 150ft., revolutions 20 per minute. This engine is not yet finished. A very similar engine has, however, been erected to lift the sewage of Boston, and this engine has been described as follows in the specification of the city engineer, Mr. J. P. Davis. The principal difference between the sewage engines and the water supply engines is that the fly-wheel in the latter is at one end of the framing, while in the former it stands between the cylinders, as in the annexed diagram sketch. The waterworks engine has cylinders 20in. and 42in. diameter and 6ft. stroke; the pumps are 28$\frac{5}{16}$in. diameter by 6ft. stroke; capacity 10,000,000 gallons per day.

The sewage pumping station, under which head is included the filth hoist, is located at Old Harbour Point on Dorchester Bay. The filth hoist, situated about 120ft. to the north-west of the engine-house, is a structure consisting of five chambers, in four of which are hung, so as to be raised and lowered by winches, open cages, through which the sewage flows, and which retain any large floating object that would injure the pumps. They are arranged in pairs, one behind the other, so that one may be in place when the other is drawn up for cleaning. The whole will be covered with a neat building. The filth hoist unites with the pump wells by two sewers, each 9ft. diameter, either one of which may be shut off for cleaning without interrupting the flow of the sewage to the pumps. For this purpose large gates are to be placed in the filth-hoist chambers. The two sewers, changing their form of section and dimensions when they reach the foundation walls of the engine-house, extend the whole length of the house, and between them are to be the pump-wells and engine foundations. The pumps of each engine are to be placed in a well provided with gateways at the ends, so that their supply may be drawn from either or both of the before-mentioned sewers.

Each pump-well can be emptied for access to the pumps, or for cleaning, without interfering with the flow to the other wells. The complete design for the pumping station consists of an engine-house, two boiler-houses, and a coal-house, arranged on the sides of a square, or enclosing a courtyard. They are of

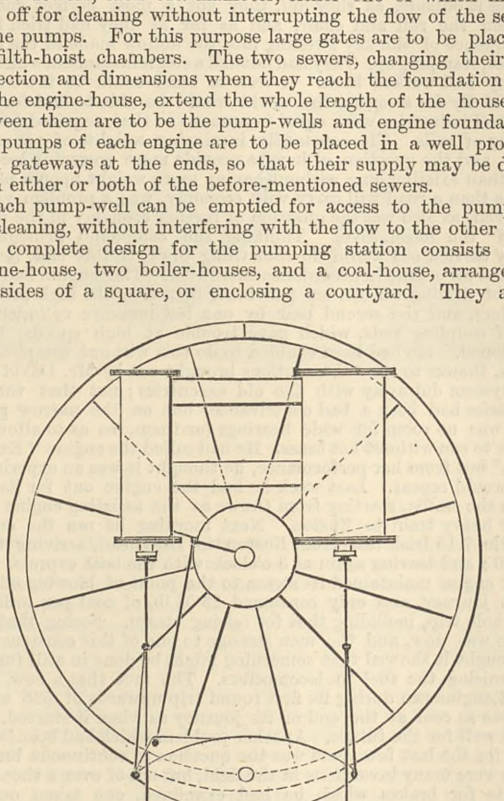


DIAGRAM OF SEWAGE PUMPING ENGINE.

dimensions to contain eight engines, with their boiler and appurtenances. Only a portion of these buildings will be erected at first, but they are so designed as to admit readily of extension. The foundations for five engines only are building now. The coal-house will be connected with a wharf for vessels and steamers by an elevated tramway. The coal will be hoisted from the vessel to cars, which can be run into the coal-house on the tramway, at an elevation of 10ft. or 12ft. above the floor, and there dumped. Four engines, each of a capacity to raise 25,000,000 gallons in twenty-four hours to a maximum height of 43ft., have been or are to be contracted for. Two of these are to be built by the Quintard Ironworks, of New York, from designs by Mr. E. D. Leavitt, jun., and the committee has authorised its chairman to contract with Mr. Geo. H. Corliss, of Providence, R.I., for two others, to be built from designs of Mr. Corliss.*

* Built by Mr. Corliss, but contract repudiated by committee.

The Leavitt engines are compound beam and fly-wheel engines, each working two single-acting plunger pumps. The steam cylinders are 15ft. 2in. apart, one over each end of the beam. The steam, as it flows from one cylinder to the other, passes through a reheater and is thoroughly dried. In the design of these engines particular attention has been given to the following conditions:—(1) The distribution of the weight of the engine, so as not to produce concentrated pressure upon any point of the foundations. (2) Great strength in the details and combination of the parts, to render the liability of breakage a minimum. (3) A proportion of the wearing surfaces, such as will allow of an uninterrupted running for extended periods with the least wear. (4) Easy accessibility of all the parts for examination, repairs, and renewals. (5) An adaptation of the pumps and their valves to the peculiar duty required of them—*i.e.*, to allow of the passage of rags, sticks, and such other small bodies as will not be detained by the filth hoist—and, in addition, a construction that will admit of the easy removal of an entire pump, or any of its parts, without disturbing any other prominent part of the engine. (6) A high degree of economy in the consumption of coal.

The steam cylinders will be vertical and inverted, one high and one low-pressure for each engine, with pistons connected to opposite ends of the beam. The pumps will be hung underneath the engine bed-plates in deep masonry pits, and the plungers will be rigidly connected, by suitable rods, to the piston cross-heads. The high-pressure piston, with its attached pump plunger, will make its upward stroke at the same time that the low-pressure piston and its plunger are making their downward stroke, and *vice versâ*, thus producing a double action in the pumps. There will be heavy cast iron girders built into the masonry forming the pump pits and engine foundations, upon which, by means of adjusting screws, the entire weight of the pumps, or such part thereof as may be deemed advisable, can be placed. These girders will also serve as a track upon which, by means of permanently attached wheels, the pumps may be run back to a position where they can be hoisted out of the pits without interfering with the fixed parts of the engines. The pump valves will be rubber flaps with wrought iron backing and washer plates; the rubber faces bearing on cast iron seats inclined at an angle of 45 deg. Each valve will cover an opening 4$\frac{1}{2}$in. by 13$\frac{1}{2}$in. There will be thirty-six suction and twenty-seven delivery valves in each pump. The discharge from the pump under the high-pressure cylinder will pass through the delivery chamber of the other pump, to which other pump will also be connected a force main, 48in. diameter.

The pedestals for the main beam pin will rest upon a central bed-plate, consisting of a transverse girder, and be rigidly bolted to the beams of the engine bed-plate; thus making a pair of connected girders, resting at their ends upon the masonry piers of the foundation, and supported at the centre by the transverse central bed-plate. The ends of the transverse bed-plate girder will rest upon and be bolted to the central foundation piers. Suitable cast iron hangers will connect the bed-plate girders with the upper chambers of the pumps. The cylinders and the crank shaft bearings, also the valve gear, will be carried by a massive framing, consisting of an entablature supported on eight columns for each engine, four of which will serve as guides for the piston cross-heads, and the other four as diagonal braces. The feet of columns will be securely keyed and bolted to the bed-plates. The centre of the crank-shaft will be in the same vertical plane as the centre of the main beam pin, and the connection from the beam to the crank will be from a horn cast on the upper flange of the beam, in such a position as to insure the proper vibration of the connecting rod.

The steam distribution will be effected by gridiron slide valves, having a short horizontal movement, which will be imparted by revolving cams fixed on a horizontal shaft running along the bases of the cylinders, and driven by suitable gearing from the crank shaft. The cut-off will be adjustable, and controlled by a governor.

The cylinders will be thoroughly steam-jacketted on sides and ends, and the exhaust from the high-pressure on its way to the low-pressure cylinder will pass through reheaters filled with tubes containing either high-pressure or superheated steam. All heated surfaces to be thoroughly protected from radiation by approved non-conductors and handsome black walnut or mahogany jackets.

There will be suitable galleries of cast iron plates, with wrought iron polished stanchions, and brass hand-rails surrounding the establatures, to be reached by substantial iron stairs at either end of the engines.

There will also be iron floors between the engine bed-plates, and around the top of the pumps; all to be furnished with finished brass hand-rails. The high-pressure cylinders will be 25½in. and the low-pressure cylinders 52in. diameter, and the stroke of the pistons will be 9ft. The pump plungers will be turned 48in. diameter, and have a stroke of 9ft. The radius of the crank will be 4ft.; radius of beam to end centres, 8ft. 3in.; radius to centre for connecting-rod attachment, 7ft. 4in.; distance, horizontally, between centres of steam cylinders, also between centres of pumps, to be 15ft. 2in. Distance of engines apart from centre to centre, 18ft. Diameter of fly-wheel, 36ft.; weight of same, at least 36 tons. The speed of the engines for capacity will be 11 revolutions per minute. The condenser will be of the jet type, and salt water will be used. The air-pump will be double-acting and horizontal, lined with brass, and fitted with rubber valves, working on brass gratings. The working boiler pressure will be 100 lb. per square inch—above the atmosphere. The steam cylinders being directly over the pumps, and having a direct connection with them, very little work is transmitted through the beam, and in consequence the strains upon it and its pin are reduced to a minimum. Each engine is to be connected with the outfall sewer by a 48in. cast iron force main.

The outfall sewer begins at a point about 200ft. south-east of the engine-house, and extends to the reservoir on Moon Island, a total distance of about 13,750ft., or 2·6 miles. It is divided into three sections:—First, the tank or deposit sewer; second, the tunnel under Dorchester Bay; third, the large sewer from Squantum Neck to Moon Island. The deposit sewer is about 1200ft. long, and is carried upon an embankment extending into the bay to the west shaft of the tunnel. Its elevation is such that sewage will flow from it to the reservoir by gravitation. It consists of two conduits or tanks, side by side, each 8ft. wide and 16ft. high, inside dimensions. It is provided with gates that either compartment may be shut off for cleaning while the other is conveying the sewage. The current through it will be quite sluggish, and all road grit and heavy material will be deposited before the tunnel is reached. Conveniences are provided to facilitate the removal of the material deposited. This sewer can also be used as a flushing tank at the time the reservoir is emptying, to produce a high velocity in the tunnel. It will be built of gravel concrete, strongly stayed with iron rods imbedded in it. The tunnel, with its west shaft, forms an inverted syphon, passing under the navigable waters of Dorchester Bay.* Its horizontal length is about 6970ft., and the average depth of the shafts below mean high tide is 145ft. to the bottom of the tunnel. Its cross section is a circle of 7¼ft. diameter. With the exception of that of the shaft, the excavation will be entirely in rock, and will be lined with brick masonry with, at least, a thickness of 12in. The profile of the syphon shows, first, a vertical descent of about 150ft., next, a nearly horizontal stretch of about 6070ft., and, lastly, a rising incline of 1ft. vertical to 6ft. horizontal distance. It is not intended that any heavy material, like sand or road-grit, shall enter the syphon, as there is ample opportunity for all such matter to settle out of the sewage in its sluggish flow through the deposit sewer, but should deposits occur they can be easily removed or flushed out by using the deposit sewer as a flushing tank, to aid the engines in producing and maintaining a high velocity. By these means a velocity may be obtained which would sweep along whole bricks. The four engines alone, running at full capacity, will give a velocity in the tunnel of 3½ft. per second. The large sewer from Squantum Neck to the reservoir is carried upon an embankment, and is 11ft. by 12ft., interior dimensions. It is large enough to receive the flow from the high-level sewer, when the latter shall be built. It needs no special description.

The reservoir has four compartments, and will hold nearly 25,000,000 gallons of sewage. Its design is such that it can be conveniently enlarged at any time to double this capacity. It will be built with rubble masonry walls and concrete floor. The London reservoirs are covered with brick arches and earth, but it is hoped and expected that it will not be found necessary to cover this one. As a precaution, however, foundations for columns will be built, that a wooden covering may be put on if experience should prove that one is needed. A large number of gates are provided for admitting and discharging the sewage, which are to be opened by hydraulic pressure, as are those at the pumping station. The sewage enters the reservoir from the outfall sewer, which passes along the northerly ends of the four compartments; it discharges into the outlet sewer, which also passes along the northerly end of the reservoir, directly under the outfall sewer.

The outlet may be divided into four sections:—First, the length above mentioned, consisting of two sewers, side by side, one 12ft. by 8¼ft., and the other 8ft. by 8¼ft., internal dimensions; second, a chamber where the flow of the outfall sewer, during the time the reservoir is discharging, unites with that of the outlet; third, two sewers placed side by side, each 12ft. by 10ft. 10in. internal dimensions; and, fourth, a pier extending out to the tidal current which passes the end of Moon Island, and carrying eight sewers, each 6ft. square and built of wood. The drainage from buildings and the streets will be received by the existing sewers as heretofore; from these it will flow into the intercepting sewers, thence into the main sewer, and by it be conveyed to the pumping station. Here it will arrive at a level about 11ft. below low-tide, and will be raised by pumps an average height of about 35ft., that it may flow by gravitation through the outfall sewer to the reservoir. It will accumulate in the reservoir during the time of one tide and be discharged into the harbour in the two hours after the ebb tidal currents are well established. During the time the sewage is stored much of the matter in suspension will settle to the bottom of the reservoir. It is the intention to sweep this deposit into the harbour by the action of the discharging currents, aided by mechanical means; but should this be found objectionable, it may be hoisted out and deposited on the land. As, however, its specific gravity will be but little greater than that of water, and as it will consist almost entirely of destructible material, it is thought no serious injury will be caused by its discharge into tide-water. As there will be no interference with the tidal currents to diminish the scouring force, and as the existing channels are maintained by these currents, it is highly improbable that so light a material as sewage sludge, bearing about the same relation to the water that feathers do to the air, will form deposits in the channels themselves.

The sum expended to January 1st, 1880, chargeable to the appropriation for "Improved Sewerage," is £213,323.

OTTO *v.* LINFORD.—A meeting of manufacturers and users of and others interested in gas motor engines is to take place at the Cannon-street Hotel, Room 6, on Wednesday, 22nd, at 3 p.m.

* Illustrated in THE ENGINEER for January 20th and 27th.

MR. F. W. WEBB ON RAILWAY MATTERS.

SPEAKING at the annual dinner of the Manchester Association of Employers, Foremen, and Draughtsmen, held at Manchester, on Saturday, Mr. F. W. Webb, of Crewe, the president, spoke at length on matters connected with the management of railways. Alluding to the increased use of steel he claimed that the London and North-Western Railway Company had been the first great firm to recognise the importance of the improvements of Bessemer and Siemens. Steel had been substituted in nearly every portion of the locomotive which formerly was made of iron. At present the company had 1679 engines with steel boilers, and so far they had every reason to be satisfied with the result. The company was also one of the first to use Bessemer steel plates for its passenger vessels. It now had four first-class steamers constructed of this material running regularly between Holyhead and Ireland, and from the examination made from time to time of the hulls of these vessels it was found that the material admirably answered its purpose. The plates had been manufactured under his superintendence. They had the misfortune last year to get one of their steel vessels on a sunken rock at the entrance to Carlingford Loch. Had it been built of iron he felt certain it would have become a total wreck. As it was 90ft. of her keel passed over the sunken rock, which bulged it in some places to the extent of 5in. or 6in., but there was not a single crack in the plates, and no water got into the vessel. Notwithstanding improvements in material, the quantity of rails annually required for repairs and renewals on the London and North-Western Railway was now 20,000 tons. For every mile run, the actual loss of rails was about one-third of a pound of steel, so that on the London and North-Western Railway 15 cwt. of steel disappeared from the rails every hour of the day. The collective wear-and-tear of locomotives on the London and North-Western Railway necessitated a new engine being put into the traffic every five working days. The question of the future permanent way was a very important one, and one that sooner or later would have to be dealt with, as with the immense consumption of wooden sleepers going on all over the world, we would be sure in a short time to find ourselves on the very verge of a terrible famine. They had tried to solve the problem themselves on the London and North-Western Railway by introducing a sleeper made of iron or steel, the chairs themselves being made of steel, worked up from the crop ends of rails. Most of the schemes which had been adopted had failed for want of elasticity from the facts that the bolts and nuts had been used to a large extent. In the chairs on which several miles had been laid down on the London and North-Western Railway they had tried to avoid all these defects, and certainly they had every promise of success. Between the surface of the chairs and the rail, and also between the rail and the sleeper, a sheet of bitumenised brown paper was placed before the chairs were rivetted by hydraulic power to the sleeper itself. This was intended to obviate the grinding away of the metal surfaces. The wooden key had been retained, and placing it outside, as they did, they got a most perfect cushion between the rail and chair, and as far as they had tried it, in consequence of the key swelling into the hollow made in the chair bracket, stamping up. They had not had a single instance in which the the key had worked back. If iron or steel could be introduced successfully for sleepers, the world would be able to find for iron and steel industries work equal in amount to that required for the making of rails. The constantly increasing weights of passenger trains, and the question of how to provide more powerful locomotives than existing ones without having more weight upon a pair of wheels than a road will carry with economy, was a problem yet to be solved, as also was the question of further economy in the working of the locomotive. Thinking the compound principle if simply carried out would do something towards this end, he had designed an engine in accordance therewith. The engine had two pairs of driving wheels, one pair being driven by the high-pressure cylinders, and the second pair by one low-pressure cylinder, the use of coupling rods, which gave trouble at high speeds, being abandoned. He had been enabled to do this without complicating things, thanks to the valve motions brought out by Mr. David Joy. This system did away with the old excentrics; not that the old excentrics had been a bad contrivance, but on the narrow gauge there was no room for wide bearings for them, so as to allow the engine to run without hot brass. He had called the engine "Experiment," but from her performance, he thought it was an experiment they would repeat. Last week he had the engine out for its first run in the traffic, starting from Crewe as the assisting engine with a very heavy train to Euston. Next morning he ran the engine with the 7.15 Irish mail from Euston to Holyhead, arriving there at 1.40; and leaving again at 3 o'clock with the boat express.

The engine maintained its steam to the point of blowing off the whole journey, and only consumed 23·54 lb. of coal per mile for the whole trip, including that for raising steam. Seeing that the engine was new, and the men strange to one of this construction, he thought it showed that something might be done in still further economising the fuel in locomotives. The fact that a new compound engine ran during its first round trip upwards of 528 miles, and was as cool at the end of its journey as when it started, promised well for the future. Another problem which had been before them for the last few years was the question of continuous brakes. There were many inventions in the field, but out of over a thousand patents for brakes which he had examined, one taken out by Messrs. Swinburne and Laining in 1865 had the germ of a good many of them. Most of the leading engineers had been against the automatic action, firmly believing that these machines would be more liable to cause mischief than to help in avoiding it, and this belief had been verified by more than one unfortunate accident. On looking at one of the engineering papers, which were supposed to deal impartially with these questions, he was really surprised to see the remarks made in one of them relative to the Blackburn accident. The paper went so far as to state that a snubbing had been given by the President of the Board of Trade to one of their oldest and most respected officers. The fact was, there was not so much nubbing in it, after all. The appendix to the report states things very clearly. It is essential the defects in the automatic brake should be provided against, and every precaution taken to insure the brake acting only when required. So far as the principal English railways were concerned, they were arriving at a solution of the difficulty, and they had to thank in some degree Messrs. Gresham and Craven, who had rendered considerable assistance, and who had made the manufacture of the necessary details a speciality.

THE ROXBURGH.—This fine vessel was taken for trial trip last week upon the measured mile off the Tyne. She is an excellent specimen of the modern type of first-class steamers built for cargo purposes without reference to passenger trade. Her dead weight capacity is 3200 tons, and her machinery consists of two boilers of 15ft. diameter, each containing four furnaces, the working pressure being 80 lb., and cylinders of 36in. and 68in. diameter by 45in. stroke. The results of the trial were as follows:—

No. of run.	Steam Pressure.	Vacuum. inches.	Revolutions per minute.	Observed Time. m. sec.	Knots.
1	80	28	71	5·44	10·465
2	80	28	71	4·50	12·413
				Mean speed	11·439

The indicated horse power developed was 1206, and the machinery worked without a heated bearing, although the vessel had not previously been under weigh. The Roxburgh has been built by Palmer's Shipbuilding Company under the superintendence of Mr. J. F. Flannery, London, and will forthwith commence service in the line from London to the Cape.

THAMES BRIDGE ACCOMMODATION.—An influential conference of shipowners, merchants, and manufacturers of East and South London was held at the Board-room of the East and West India Dock Company, Billiter-street, on the 9th inst., to consider the question of communication between the north and south of the Thames east of London Bridge.

PORTSMOUTH DRAINAGE.—The arbitrators, Sir Joseph Bazalgette and W. Bayley Denton, have selected three designs in this competition to be submitted to the Town Council, they are marked "Multum in Parvo;" "M.M.I.C.E.;" and "Delta;" their respective authors being Mr. C. C. Adam, borough engineer, Portsmouth; Messrs. Quick and Son, Westminster; and Mr. Llewellyn Lloyd, C.E., London, formerly town surveyor, Bilston. The premium offered by the Corporation was 500 guineas.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Feb. 11th, 1882:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 9910; mercantile marine, building materials, and other collections, 2396. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 4 p.m., Museum, 1401; mercantile marine, building materials, and other collections, 566. Total, 14,273. Average of corresponding week in former years, 12,945. Total from the opening of the Museum, 20,721,516.

IRON AND STEEL INSTITUTE.—The Council of this Institute have accepted the invitation of the Austrian iron trade to hold their next autumn meeting in Vienna. The meeting will commence on September 20th next, and is expected to last over several days. It is understood that excursions will be made to different points of interest to the iron trade in Austria, including the capital of Hungary (Pesth) and the capital of Styria (Gratz), one of the very oldest iron-producing districts on the continent of Europe. The meeting will present many features of attraction, and the gathering is expected to be large and influential. The spring meeting will be held as usual at the Institute of Civil Engineers, commencing on May 9th.

SEA-GOING TORPEDO BOATS.—On Saturday last a trial of the first of two improved first-class torpedo boats of the Batoum type, built by Messrs. Yarrow and Co. for the Argentine Government, took place on the river Thames, in the presence of the Argentine authorities, when a mean speed of 19·7 knots was obtained, fully equipped and ready for action. These boats will be rigged to sail direct from London to Buenos Ayres. The seaworthiness of this class of torpedo boat has long since been placed beyond all doubt. Two similar vessels were sailed across the Atlantic last year, and arrived in perfect safety, in addition to which Messrs. Yarrow have already sent no less than eleven of them round to the Mediterranean ports, and in no case has any accident occurred, although in some instances very boisterous weather was encountered.

THE INSTITUTION OF CIVIL ENGINEERS.—It was announced at the last meeting that the Council had recently transferred D. S. Baynes, J. Brown, W. B. Myers, and J. M'Wrench to the class of members; and had admitted H. C. Ayris, F. W. Bach, H. B. Baldwin, W. Bates, O. Bell, G. L. Burton, E. H. Byng, F. H. T. Chamberlaine, N. D. Douglass, E. R. Gardiner, W. Giles, H. Graham, C. E. Hannaford, H. S. Hawkins, A. Hemingway, R. J. Money, J. F. L. Nowell, J. S. Page, T. G. G. Pearce, A. D. Prouse, F. Rose, jun., R. E. Sexton and J. Swart, as students. At the monthly ballot G. M. Barr, T. M. Barr, D. M. Beere, T. G. Bezzi, W. Drennan, the Hon. G. A. H. Duncan, H. Haworth, A. W. H. James, J. Macrae, W. G. Pearson, A. D. Stewart, and W. H. White, were elected members; C. X. J. Allman, B. W. Beever, Stud. Inst. C.E., T. B. Bewick, Stud. Inst. C.E., A. H. Curling, H. F. Donaldson, H. G. Duguid, L. S. R. Ewing, E. Hamilton, Stud. Inst. C.E., J. Holden, J. H. C. Langdon, D. Macalister, Stud. Inst. C.E., E. G. J. McCudden, G. J. Monson, Stud. Inst. C.E., F. C. Powell, S. Prestige, Stud. Inst. C.E., his Highness Prince Prisdang, E. P. Rathbone, Stud. Inst. C.E., R. H. Read, W. S. Rendel, Dr. E. Savich, Khan Bahadur S. Sorabji, L.C.E., W. D. Seaton, Stud. Inst. C.E., C. de G. Sells, Stud. Inst. C.E., H. L. Stables, A. M. Thompson, J. M. Thornton, C. F. Tufnell, Stud. Inst. C.E., G. R. Tyndall, Stud. Inst. C.E., T. H. Williams, E. W. N. Wood, Stud. Inst. C.E., D. F. Worger, Stud. Inst. C.E., and J. D. Young, associate members; and Lieutenant F. A. de P. B. Brandao, an associate.

CLOG SOLES AND WOODEN SHOES.—A visit of Lord Claud J. Hamilton, M.P., to the works of the Mersey Wood Working Co., Bedford-place, Bootle, is the occasion of the following particulars in the *Bootle Times*:—The principal manufacture carried on at these works is that of wooden soles for what are called in Lancashire "clogs," in France "sabots." Familiar as are the "wooden shoon," few persons would conceive how ingeniously the manufacture of the soles is conducted and how vast are the quantities which are issued daily, weekly, and hourly from these works. The yard was first visited where there is usually stored from two to three thousand tons of timber. The native timber is first stripped of its bark, the foreign logs being already barked when imported. The logs are then raised from the yard by a crane and cut up by circular saws into segments averaging about a foot long. These segments are next cut into planks of convenient size, a dozen saws working at once and the planking being effected with marvellous rapidity, about sixty tons of wood being cut up into clog soles every day. On the side of each plank a metal gauge is laid, and a girl with a pencil roughly outlines the size and number of soles which can be cut from it. The planks pass on to a band saw, where they are cut up into blocks with the required curvature for a sole. Thence they pass to the roughing machine which roughly shapes them. Another machine cuts the sides; another shapes the shanks; yet another rounds the heels; and yet another shapes the toes. They pass next to a revolving cutter which roughly hollows the upper side of the sole, and subsequently this hollowed surface is smoothed in another machine. They pass next through the various finishing machines, where the bottoms, sides, shanks, heels, and toes are successively rendered perfectly smooth by friction with swiftly revolving bands covered with a mixture containing ground glass and other attritive materials which scour them in the same way as if with sand or emery paper. They next go to the gripping machine which bevels the edges, leaving a "grip" to which the leather boot uppers can be fastened. It will thus be seen that the sole of each wooden shoe, from the time when the log of wood is first cut into segments to the time when the edges are bevelled by the gripping machine, passes through fifteen distinct machines, and as the required sections are marked by hand, and the right and left sides of toes and heels are separately shaped, each sole passes through the hands of eighteen different workpeople. Perhaps the advantages of the "division of labour" have never been exhibited in any manufacture with more remarkable results. The motive power for these various processes is supplied by a pair of 60-horse power compound high and low-pressure condensing engines. The waste wood is also manufactured at these works into a valuable commercial product. It is chopped up by machinery, treated with chemicals, steeped to a condition of softness, and all knotty pieces having been removed, the softened woody fibre is drained and compressed between a series of rollers until it is transformed into sheets of pulp, or rather half-made paper, which is supplied to paper manufacturers, and being mixed with other materials is transformed into some of the best qualities of paper. Lord Hamilton was shown a sample of fine rose-tinted note paper which was made chiefly from the waste cuttings off wooden clog soles. The works include a chemical laboratory and joiners', fitters', and grinders' shops. The extensive cellars are stored with clog soles, which are kept there for the time necessary to season the wood before being finished, and vast quantities of finished goods are passing daily from the ware-rooms to English, continental, and colonial markets. Lord Hamilton inspected every process with considerable interest, and we imagine that to him and to others who may read this description of what he saw, "the clang o' the wooden shoon" will henceforth acquire a new significance.

THE EDISON LIGHT.

IN *Chambers' Journal*, and in some of the technical papers for July, 1863, there is to be found an article on the electric light. This article, like all others of its kind, is extremely interesting, dealing as it does with the history of the subject. The literature on the theory of the subject is interesting to another class of readers. In this article the work of Messrs. Greener and Staite, exhibitions of which were given in 1847 at several places in London, is discussed, and the following sentences are instructive:—"They devised a mode of enclosing small lumps of pure carbon in air-tight vessels, and rendering them incandescent or humorous by means of galvanic electricity." Other lamps involving a train of clockwork to keep the relative position of the carbon points constant were devised. Of such we read—"But these ingenious inventors, notwithstanding all their praiseworthy endeavours, could not obtain a steady light; it *would* flicker and intermit, and failed to become practically useful, although they fondly hoped—as they declared—that streets and buildings might thus be lighted at one-sixth the cost of gas." Even if the light had been steady, and thus have commended itself, the mathematicians with their cool calculating power, and to investors seemingly cynical results, soon showed that the burning of zinc to produce the electric light was far from economical, and could not because of its cost come generally into use. Time went on. Dynamo-machines replaced the galvanic battery; the electric current was cheapened by the combustion of coal as the first cause, instead of zinc; the electric world was moved to its vitals by certain successes; yet the old idea of incandescent lighting was pooh-poohed till Messrs. Swan and Edison showed us to be wrong. Swan experimented off and on for twenty years. Edison commenced, we believe, after the Eclipse expedition a few years ago, during which a sensitive instrument of his had been on trial. The Wallace-Farmer machine excited his inventive faculties, and he turned to test the possibilities of electric lighting. He passed through the ordinary course of experiments with the more infusible metal, and at length came to the conclusion, as every other experimenter before and since has come, that carbon, and carbon only, was the substance to be used. We wonder who will be the first to discover a real rival to carbon? Having decided to use carbon, the next question was the material from which the carbon should be obtained. A process of differentiation soon showed that vegetable carbon only was useful, and that obtained from grasses was selected. From north and south, from east and west, materials were obtained and tested. We illustrate, on page 118, specimens of bamboos brought from South America, Japan, &c., for the purpose of these trials. Each bamboo was exhaustively tested, till at length a certain one was selected for use. The following are the names of the canes illustrated in the figures:—(1) Hauchikee, from Japan; (2) Nebuchitakee, from Japan; (3) Shiho Jikee, from Japan; (4) Sugar Cane, from Venezuela; (5) Horteichikee, from Japan; (6) Kuraichikee, from Japan; (7) Matakee, from Japan; (8) Brazilian, from Para, Brazil; (9) Hauchikee, from Japan; (10) Shikakuakikee, from Japan; (11) Mountain Bamboo, from Japan; (12) Shikakuakikee, from Japan; (13) Brazilian, from Para, Brazil; (14) Shikakuakikee, from Japan; (15) Japanese, from Yokohama, Japan; (16) Torachikee, from Japan; (17) Chinese, from Hong Kong, China.

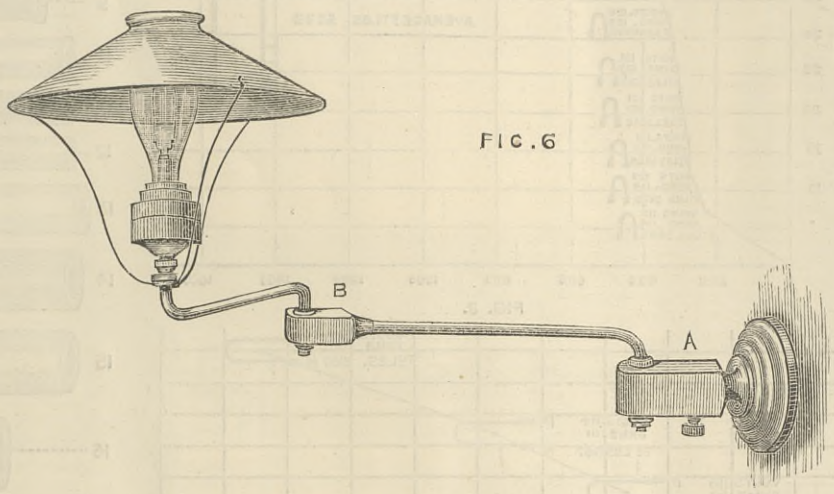


FIG. 6

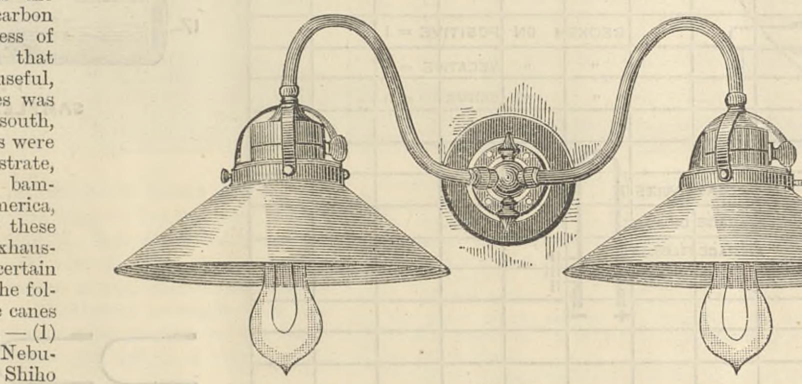
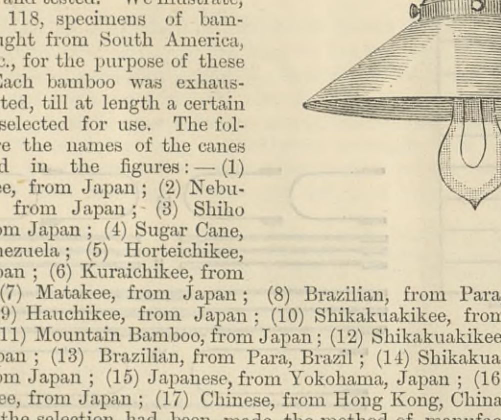


FIG. 9

When the selection had been made, the method of manufacture was carefully considered and every detail arranged, so that the manufactured article should be produced at the lowest cost. Fig. 2 shows the processes of manufacture. The bamboo is taken of proper length 1, and split into two parts 2, 2. Each of these parts is divided into three smaller parts, which are pared down to separate the pithy from the stronger fibrous texture, shown in 3, 4, 5, 6, and 7. When No. 7 stage is arrived at the strip is cut in the shape shown in 8, the thicker ends being so left to obtain good contact, or shaped as in No. 10, when carbons for the smaller lamps are required. Each strip in No. 10 forms two, as in No. 11. The next stage to Nos. 8 and 11 is the carbonisation of the fibre.



EDISON WEBER METER.

Of course, the process of carbonisation is of somewhat a delicate nature, and care has to be taken, or the previous work might easily be spoiled. The filament, as we have said, is shaped before the carbonisation. The filament shaped as Nos. 9 and 12 is laid in a groove cut in a metal case—generally the metal used is nickel—which groove is covered to render it air-tight, and so prevent combustion. The filament so protected is placed in the furnace and raised to the temperature required.

To show how exhaustively Mr. Edison carries out his experiments, we give diagrams Figs. 3 and 4, showing tabularly how the information as to the better materials was obtained. Fig. 3 shows an example of a bad material, Fig. 4 of a good one. These diagrams are very instructive, showing as they do the time after which the carbon broke, under what current and at what points. The processes in the manufacture of the lamp itself are very simple. The lamp consists primarily of two parts, one the central stem, as shown in Fig. 5, No. 11, of glass into which are fused the conducting wires, to the ends of which the carbon filament is fixed as in Nos. 12, 13, 14, the other the globe proper. The lamp is exhausted from the top, and when exhausted sealed to prevent entrance of air. One conducting wire is in contact with the screw at the lowermost point of the lamp, whilst the other is in electric contact with a brass ring around the rim of what we may call the stem of the lamp. No. 4 shows how the exhausting tube No. 3 is fixed to the globe No. 2, whilst Nos. 5, 6, 7, 8, 9, 10, 11, show the processes undertaken to form two of the inner stems.

We have thus far followed what seems to be the natural order of things—we have shown in previous papers the arrangements made for the generation of the current, and for its safe conduction through mains to the houses. The lamp wires are so arranged that it seems almost impossible for any accident to happen. A strip of wood, say 3in. by ⅝in., has two grooves cut into it to hold the insulated wires, say to a lamp on a wall bracket. This lamp bracket may be of the design shown in Fig. 6, and hence movable around a centre. Sections of the joints at A and B are shown in Figs. 7 and 8. It should be understood that every lamp and every house is provided with a fusible conductor, so that should any mishap cause a greater current to flow into the conductors to the lamp, fusion at the safety point takes place and the current is absolutely stopped. The lamp is rendered useless; but who would care about a gas burner being temporarily useless if it automatically stopped a leakage of gas, and so prevented an explosion.

The current can be turned on or off the lamp by means of a tap, so that in many respects the householder who could go to sleep overnight with gas laid on, and wake up in the morning with the electrical connections made, would go about the work of getting his light just as he had always done. Figs. 9 and 10 show lamps adapted for pendants or to stand on the table, &c. A further similarity exists in the distribution of electricity and gas, inasmuch as the amount consumed of the former as well as of the latter can be measured. Fig. 11 shows the latest form of meter. The laws pertaining to electro-deposition of metals are herein utilised. It is well understood that a given quantity of electricity, whether passing in a shorter or a longer time, will deposit a certain weight of metal. The apparatus then consists of two cells placed in a shunt or branch circuit. The amount of electricity passing through this circuit in proportion to that through the main circuit is known, and hence the weight of metal deposited tells the quantity of electricity that has passed through the circuit. In practical use certain precautions are taken to counteract the effects of heat in the circuit, somewhat after the same fashion as in watches, two metals are used, expanding differently under the influence of heat. In the cell, for example, a rise of temperature decreases the resistance, and a compensating arrangement is therefore made in the circuit by inserting, say, a copper resistance, which resistance increases as the temperature rises. Another form of meter was described in our issue of November 4th, 1881.

With reference to this method of measuring electrical currents we may call attention to the admirable series of experiments undertaken by Dr. G. Gore, F.R.S., which supplies information regarding the degree of accuracy of such experiments when made by means of electrolysis of a solution of cupric sulphate, and states the conditions under which the degree of inaccuracy of measure is the least.

THE ROYAL INSTITUTION.

THE ABSORPTION OF RADIANT HEAT.—LONDON FOG.

ON the 3rd inst. Dr. John Tyndall, F.R.S., lectured at the Royal Institution, Albemarle-street, on the "Absorption of Radiant Heat." Mr. William Spottiswoode, F.R.S., presided.

Professor Tyndall began by saying that some of the greatest superstructures of physical science depended upon a more or less ideal foundation. For instance, the undulatory theory of light could only be spiritually discerned, for the waves were far too small to be seen; it also required a mind of high ideality to conceive an ether filling all space, yet possessing the qualities of a solid. The ultimate atoms of matter stood upon the same ideal foundation. When several of these atoms were grouped together they were scientifically known as "molecules:" and the object of his address that evening was to explain the action of free molecules upon obscure radiant heat. By free molecules he meant the molecules in gases, vapours, and liquids. The invisible waves of radiant heat were longer than those of light, but inconceivably small; and there was a vast difference in the power of different kinds of free molecules to absorb these heat vibrations. They could do most in this way when they were chemically united. If a simple mixture were made of nitrogen and hydrogen gases, in the proportion of 14 to 3, and placed in a tube of wide diameter, through which a beam of obscure heat could be sent, scarcely any of that heat would be absorbed by that mixture. But if the same two gases were chemically united to form ammonia, they would stop a thousand times more radiant heat than before. It was the same with vapours. Some were as black as pitch towards radiant heat; others were highly transparent. If the number of molecules of the gas in the experimental tube were constant, the absorption of radiant heat was the same, no matter how the molecules were crowded together by the lengthening or shortening of the tube. But the molecules might further be so crowded together as to form a liquid. On trying experiments with a number of vapours, also of liquids from the same vapours, he found the mean absorption of radiant heat by the one to be 32·5, and by the other 32·9, the number of molecules being the same; so that the absorption by a liquid of its vapour is practically equal. The law is that the absorption of radiant heat remains constant through all changes between the vaporous and liquid conditions.

The speaker then stated that when impulses of light, made, say, by passing rays from the lime-light through perforations in a rotating disc, were allowed to impinge upon a small glass bulb containing vapour, sounds were given forth by the vapour, and the noise could be conveyed to the ear by means of an india-rubber tube from the mouth of the flask; the sounds were then like an ordinary organ peal, and were due to the absorption of radiant heat by each vapour tried. Some men of science had denied the accuracy of his discovery that aqueous vapour was such a powerful absorbent of radiant heat; he asked a bottle of aqueous vapour whether he was right as to its absorbent powers, and the vapour sent him a musical roar in reply. The sound was evidence that radiant heat had been absorbed.

The obscure radiation from the electric arc is eight times greater in heating power than the luminous radiation; the obscure radiation from the sun is twice that of the luminous radiation. A layer of water placed in the path of the electric light makes its radiation very much like that of the sun. Between ourselves and the sun is the aqueous vapour of the atmosphere, but at a height of 10,000ft. or 12,000ft. there is very little vapour in the air. Professor Langley, who was making observations in California at a height of 12,000ft., had just written to him saying that he found a great difference in the distribution of the solar radiation at that altitude; there was an enormous expansion of the ultra-red spectrum.

Last Friday night, in the course of a lecture at the Royal Institution, Professor Edward Frankland, F.R.S., said that the suspended matter in the atmosphere is mostly below the height of 5000ft.; probably half of it is below that level. The higher the position in the atmosphere, the smaller are the variations in solar intensity. The lower the latitude the greater might it be expected to find the intensity of the sun's rays, but this is not necessarily the case. In northern regions, coupled with the conditions of high elevation, light background, shelter, clear atmosphere, and a small quantity of aqueous vapour in the air, the solar intensity may be great. The chief evils of a town climate are—great heat in summer, gloom in winter, and so much dirt in the air, that the colours of new or freshly-painted houses soon change to a grimy hue. The darker the houses the warmer they are inside, and the cooler are the streets, and more especially is this the case in relation to the roofs; slate roofs sometimes became so hot in the sun that the hand can scarcely bear to touch them, but if they were made white outside they would be as cool as the external air. All the large towns in England are near the sea level—a condition which favours air warmth, but not direct solar warmth. The combustion of coal in towns results in the discharge into the atmosphere of vast quantities of soot, tar, and steam; the more perfect the combustion, the less tar and the more steam is given off. Mr. Robert Hunt estimates that eight millions of tons of coal are consumed annually in London, and that of these six millions of tons are consumed in the winter months, consequently the amounts of steam, soot, tar, and sulphurous acid discharged into the air are enormous. Steam supplies the basis of all fog; and the fog particles become covered with tar, which renders them more permanent; dirt in the air is necessary to produce fog. To illustrate these points Dr. Frankland took a large flask containing a little vapour of water, and with air deprived of dirt by being filtered through cotton wool; on chilling this air by expansion by means of a few strokes of an air-pump, slight mist was formed which disappeared in a moment. The effects were rendered visible throughout the theatre by means of a beam of light from the electric lamp, thrown upon the flask. The ordinary air of the theatre with its normal charge of dirt was then admitted into the same flask, and when the former experiment was repeated the fog was more dense and lasting then when air without dirt had been used. The presence of sulphurous acid in London air promotes fog, and the power of the acid to do so was proved by the lecturer by experiment. Tarry matter in the air renders fog more persistent by retarding evaporation. The power of tar to do so is recognised by some manufacturers, and used by them to economise fuel, while keeping water at the boiling point. Professor Frankland here exhibited one basin of water at the boiling point giving off its clouds of steam, and another basin of water at the same temperature giving off none at all, because the water was covered with a thin layer of olive oil, which the speaker stated to be the same in its influence under the circumstances as a thin layer of tar. Thus the products of combustion of our household fires, he said, furnish potent sources of fog, and it is a mistake to lay the blame on the discharges from the chimneys of manufacturers. If all manufactures were removed from London, no appreciable difference would be made in the amount of fog.

At the South Kensington Smoke Abatement Exhibition, he said were two great classes of grates for domestic use, namely, those which burn bituminous and those which burn anthracite coal. There are about 600,000 houses in London, and little good in the way of preventing fog will be done by improved fire-grates, he added, so long as householders use bituminous coal. There is one remedy and one only, and that is to stop the importation of bituminous coal into London. The price of anthracite coal is lower than the other, it is smokeless, and an ample supply of it and of smokeless steam coal can be had from Wales. Bituminous coal can also be rendered smokeless by coking; moreover, in the process of coking it gives off valuable commercial products. The difficulty in lighting anthracite or coke fires is overcome by Mr. Siemens' process; by an expenditure of two shillings each, every grate in London can be made to burn smokeless coal. He had proved this in his own home in spite of the grumbling of the servants at first, before they had gained experience in lighting the fires; the cost had been three shillings per grate, including blowers to facilitate lighting. The general adoption of such a system would do much to abolish the more injurious of London fogs, which always increase the death rate, more especially among persons suffering from bronchitis, asthma, and other diseases of the lungs. A cotton-wool respirator does much to prevent the choking sensation caused by London fogs, but it does not alleviate the smarting of the eyes. In any case, he added, we have little sunshine in this country, and need not make matters worse by throwing a dark unhealthy pall over ourselves.

THE MANUFACTURE OF EDISON LAMP CARBONS, AND LAMPS.

(*For description see page* 117.)

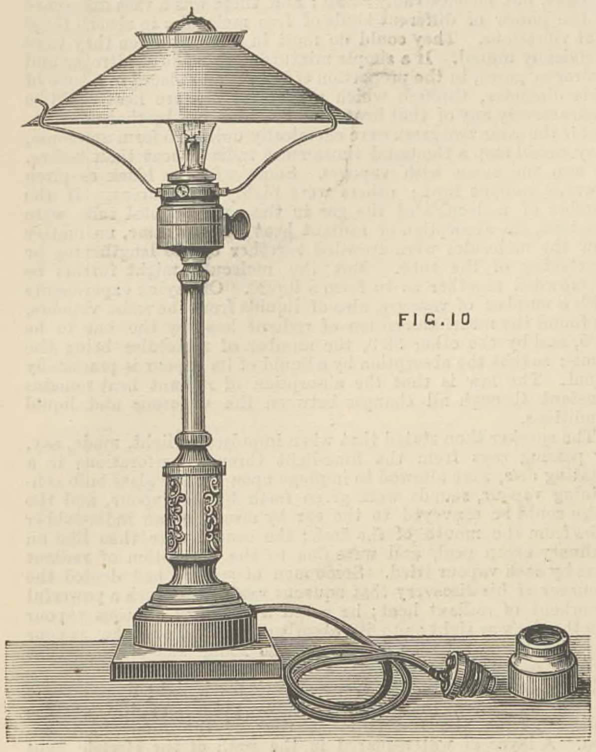


FIG. 10

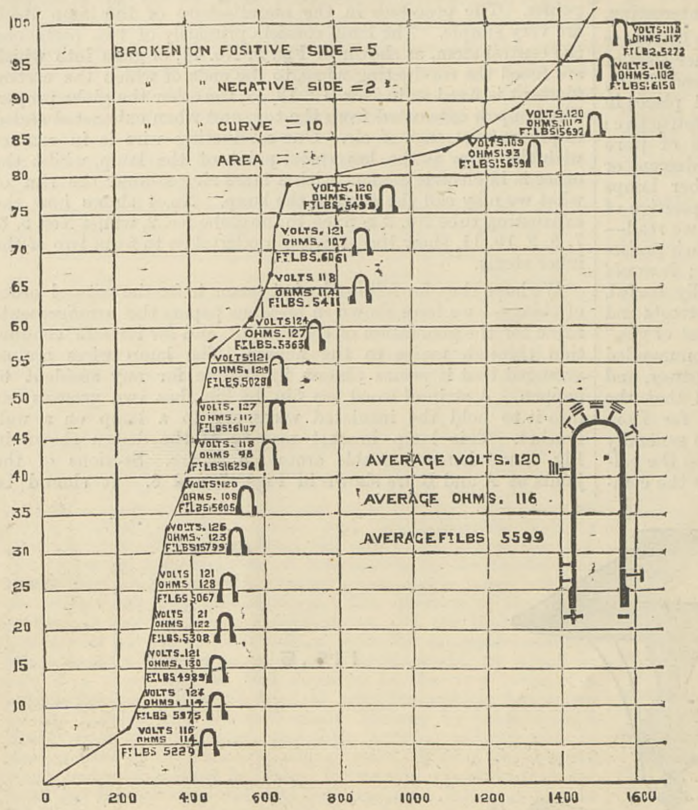


FIG. 3.

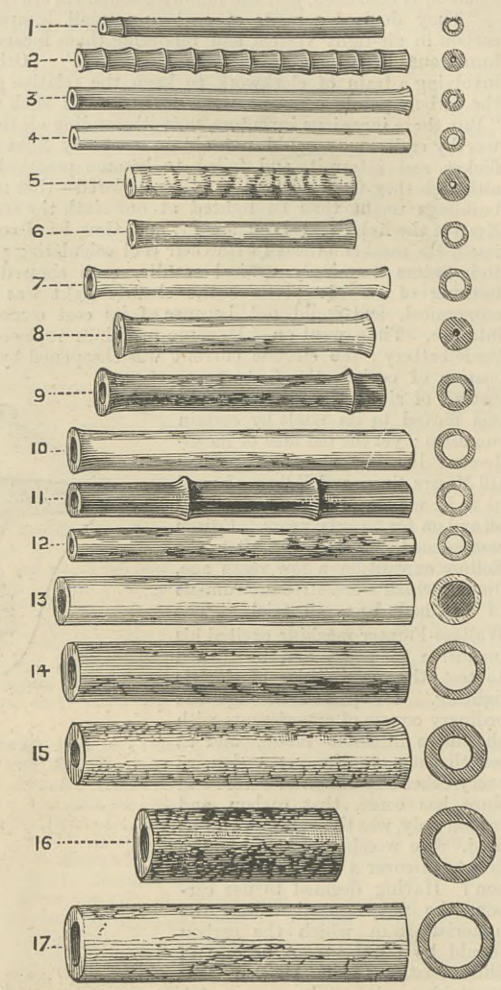


FIG. 1
SAMPLES OF BAMBOO

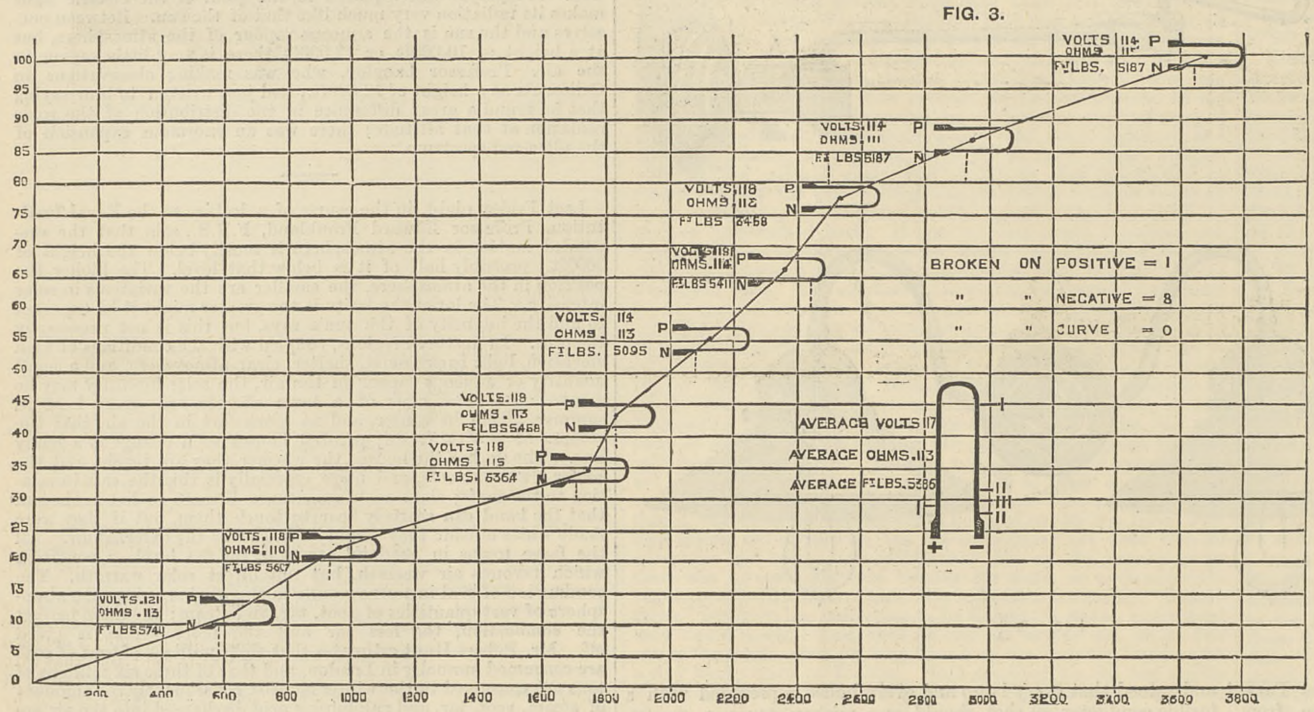
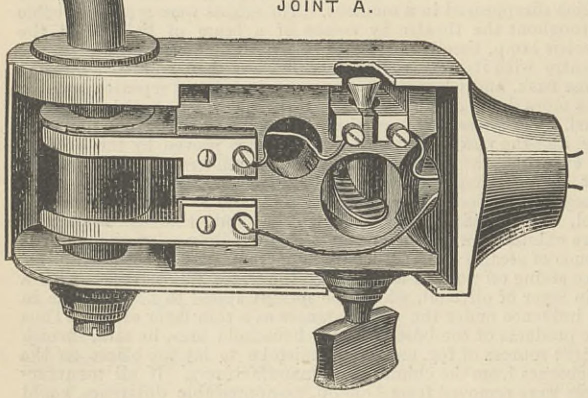


FIG. 4.

FIG. 7
WALL BRACKET
JOINT A.



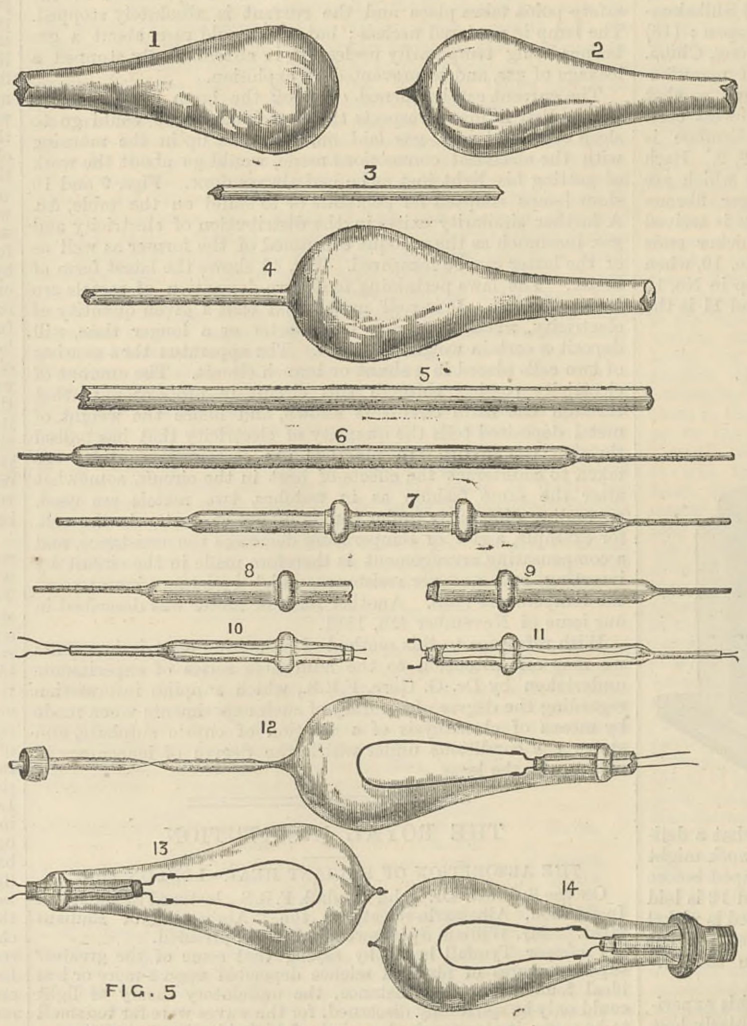


FIG. 5

PROCESSES IN THE MANUFACTURE OF THE LAMP

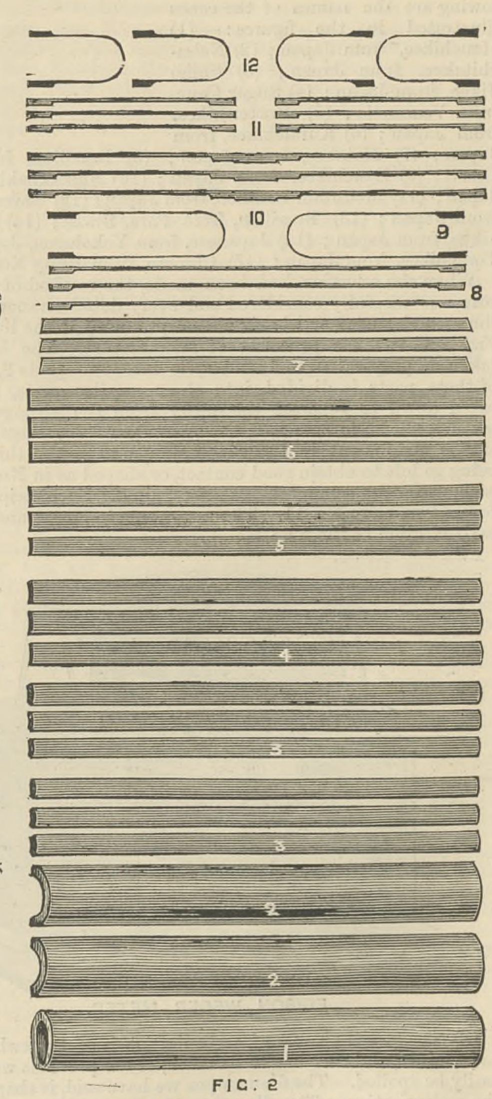
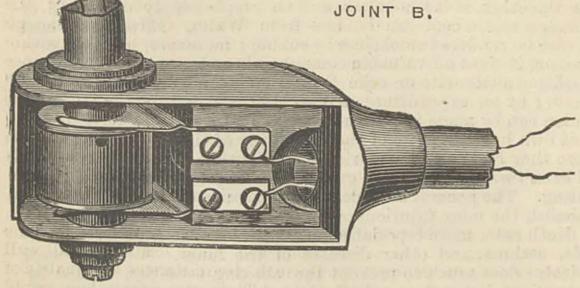
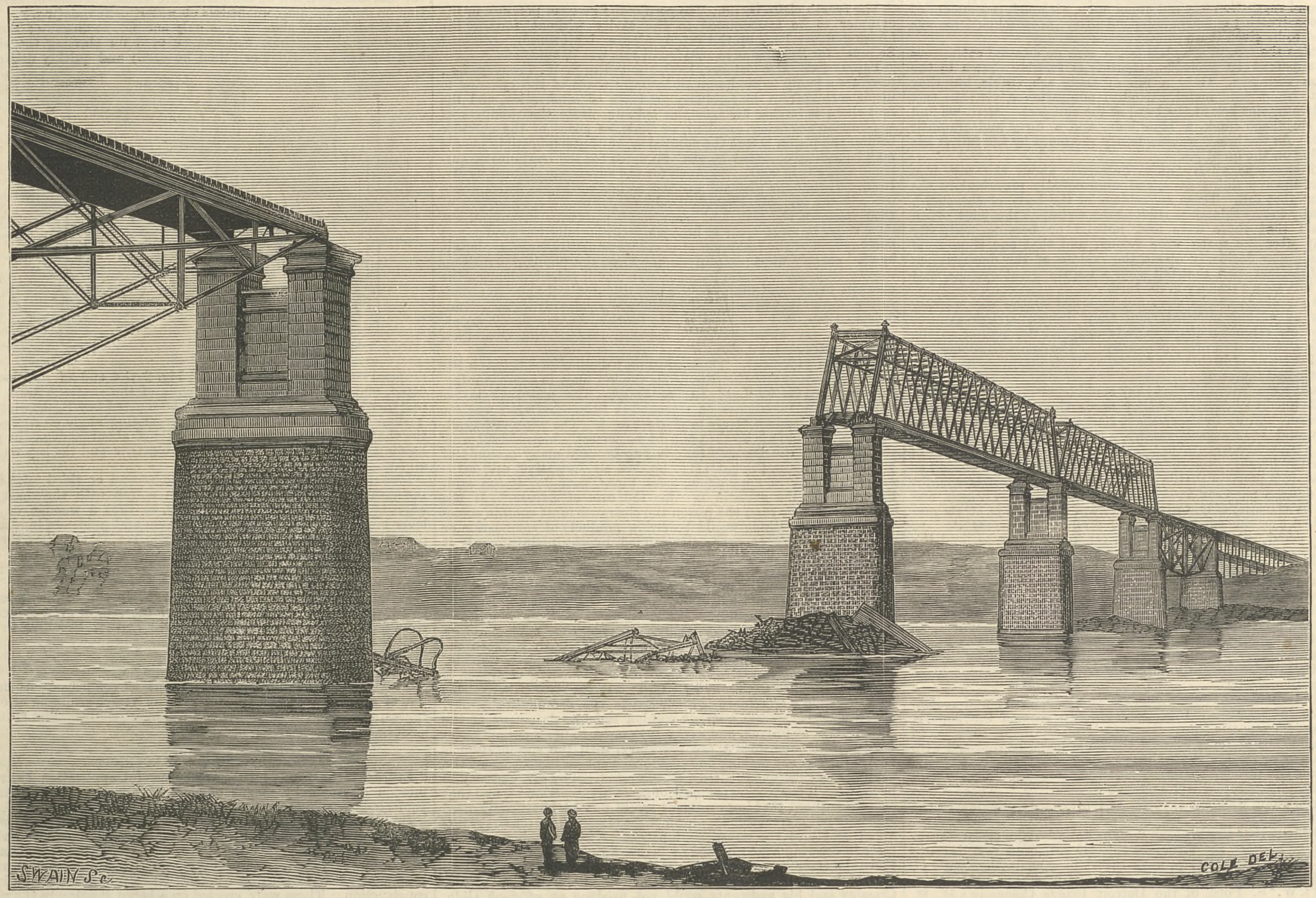


FIG. 2
PROCESSES IN THE MANUFACTURE
OF THE CARBONS

FIG. 8
WALL BRACKET
JOINT B.



THE ST. CHARLES BRIDGE, MISSOURI, DECEMBER 9TH, 1881.



THE ST. CHARLES BRIDGE DISASTER.

WE reprint from the *American Engineer* the following account of an accident somewhat resembling that which befell the Tay Bridge, and having considerable interest. On the evening of December 8th, 1881, what is known as the third through span of the St. Charles Bridge was wrecked while a freight train was crossing. Two years and one month previous, or on the 8th of November, 1875, the first through span fell, in a manner quite similar.

The first break down was the subject of wide interest in the profession. The two together are of unusual significance, and if the cause is once made clear, the moral will be found to have far more than a local application. It is our purpose here to simply describe the occurrence and offer some remarks.

At 5.30 p.m. of December 8th, 1881, as a freight train consisting of an engine with six driving wheels—known as a "ten-wheeler"—thirteen cars of stock, eighteen of dead freight, and a caboose, was going east over the bridge, span No. 4, known as the third trellis span, gave way, precipitating the whole train into the river, 80ft. below. As near as can be learned, the engine was within about four or five panels of the east pier, the train extending back and covering spans No. 3 and No. 2, and part of span No. 1. After the span had gone down the balance of the train continued to run slowly, apparently for some moments, over the west pier, until the entire train had gone over. The brakeman and others at the rear of the train got out safely on the bridge. The brakeman on the third car went down, but was found sitting on the upper chord not seriously injured. The engineer and fireman also went down in the cab; the former was lost, but the latter managed to get out with a broken leg, and was found on top o the steam dome, then above water.

The accompanying illustration gives the appearance of the wreck the following morning, as viewed from the east bank below the bridge. The diagram shows the depth of water, and is designed to illustrate the manner in which the fall occurred.

From the position in which the wreck lies, and from the marks on the piers, the following points may be stated:—The span fell nearly vertical, possibly swaying a little down stream. The middle of the fallen span is midway between the piers. The counter-braced portion appears to have been broken in the fall, and not before; the east half of it is in position on the bottom. There are no marks on the west pier made by the fallen span. The west end posts both lie some distance in front of the pier—their feet some 10ft. distant—forming with a portion of the upper chord a triangular support for the talus of wrecked cars at the pier foot. The cap-stones of the east pier are broken by the feet of the end posts; these feet cleared the main coping, 35ft. down the pier, but scored heavily the face of the pier, some 18ft. to 20ft. above the water, the up-stream mark being somewhat the lowest.

All these facts imply breakage at some point about one-fourth the distance from the end. If we suppose the upper chords to have broken at the fifth panel point from the east end, the up-stream one slightly in advance, the main facts as they now appear would harmonise with the following conception:—

The east end dragged from its place, breaking the cap-stones, the bridge as a whole rotating about the first pier, and clearing the lower coping on the east pier, until nearly down, when it launched as a whole boldly to the east, heavily scoring the east pier; thus arrested, some portion jackknifed one panel length, allowing the west end posts to reach the bottom at a distance from the pier. The position of the wreck at the west pier harmonises with this view.

The diagram illustrates this conception, and shows the supposed position of the span as it left the east pier, cleared the main coping and launched forward against the east pier, also when the fifth panel point struck bottom, and the final position taken by the prominent parts of the wreck.

An eye witness on the west bank heard a report, and looking up "the engine had settled about 6ft." It was within a few feet of the pier. The east end of the span appeared to nearly reach the water before the west end left the pier.

Another eye witness, on the east side, speaks of the bridge "going down like a hinge," about the west pier.

The fireman heard a crash above him and to the right—up stream side—and immediately the locomotive commenced sinking.

The next morning the good people of St. Charles were so excited that half the town could tell all about it, and it was impossible to obtain reliable information. The above evidence of eye witnesses on the same night, and in one case half an hour thereafter, is entitled to credence. It is in thorough harmony with the evidence of the wreck itself.

The cars in going over the end of the adjacent span carried away the end strut of the lateral system and several wooden floor beams. Had one or two more floor beams been broken the first pair of ties of the lateral system would have been destroyed and probably this span also. The track and timber system was heavily marked by the car bodies as they went over. The face and copings of the pier were also heavily marred by the falling train, but not by the span.

The immediate or special cause of the fall of this span is at present a mystery. In many particulars there appears to be a strong resemblance to the disaster to span No. 2 of two years ago. Some of these we will note. The fallen span vertically under its position when erect; the marking of the cap and face of the east pier, and the end posts lodged against it; absence of marks on west pier except those due to falling train; the west end posts some distance in front of the pier, and, the removal of the north bed-plate on the west pier, leaving the south one in position. We notice that the floor system on the adjacent span is broken further back than in the disaster of two years ago, although much stronger and better designed, a result due probably to the greater number of cars tumbling over. There are other minor points of apparent similarity.

If we knew nothing more of the former case we should be inclined to infer the manner of the breakage of the two spans to be the same. In the former case eminent experts were called in—Messrs. Morrison, Flad, McDonald, Whittemore, Wm. Sooy Smith, C. Shaler Smith, and Prof. C. A. Smith. Their evidence, along with others, is preserved in an excellent little pamphlet, edited by S. H. Yonge, A.S.C.E. We find it to be almost the unanimous opinion of these experts that the fall was occasioned by a derailed truck. On looking over the evidence on which this opinion seems to be based it appears to us to be insufficient. The wheel marks on the cross-timbers were all within a distance not much if any greater than that in which the floor system was absolutely destroyed in the last case and less han the distance of heavy scoring, and it does not seem impossible for these marks to have been produced as the cars fell over the pier after the span fell. Some colour is given to the views of the experts from the fact that markings, apparently from a fallen brakebeam or rod, were found some 75ft. back on the first span, these markings disappearing just in advance of the wheel marks. On the other hand no cross-timber clearly identified as belonging to the fallen span was found with corresponding wheel marks, and the cars were judged to be nearly in position in the wreck, except for 20ft. adjacent to the west pier.

The expert conclusion may be explained in this way: It is assumed that the bridge could not fall down except from some unusual extraneous cause; that such cause was probably a derailed truck; that evidence pointing that way was found; and, that with a train moving at five miles per hour the span might be destroyed either by breaking through the floor into the lateral system or by hitting a post. The engineer says the train was going very slow, not over three miles per honr.

We have no desire to invalidate the conclusions as to the first disaster. We submit, however, that the cause adduced should not have produced the result, and in the light of the present disaster it might be seriously questioned—"Was this the straw that broke the camel's back?"

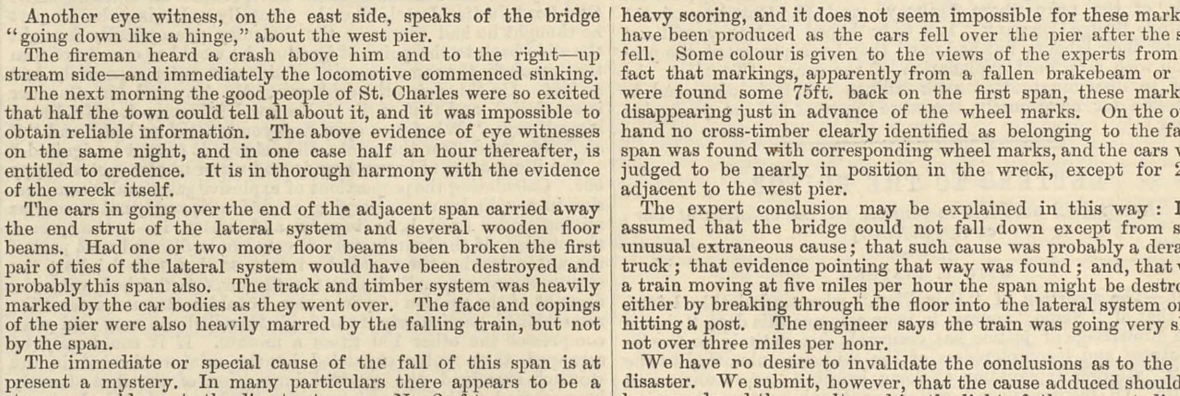


DIAGRAM OF FALL OF GIRDER.

After all, if it was necessary to reach a conclusion in this case, it is doubtful if any other could be legitimate in the light of present dicta. The metal was found to be of good quality, the design of the bridge good, the counter-bracing sufficient, although its form might be much improved, and the strains all well within the elastic limits. The test load had been greater than any since on the bridge, and the train which went down was lighter than many that crossed in the regular traffic. It is true that since this bridge was designed car loads have increased from 10 to 15 tons, and cars are now building and running for 20 tons; that engines have changed from 17 to 35 tons, to 50 to 60 tons, and a train has been known to cross this bridge inadvertently, containing a "ten-wheeler" and two "Consolidation" engines within the limits of a span.

Yet, although the bridge was designed for the traffic at the time of its building, still, as before remarked, these loads were all well within the elastic limits. Under such circumstances the quality of metal is said to remain unchanged. Then, we query, how could the experts reach any other conclusion, if they were obliged to reach one, than the one arrived at?

The experts seemed to be clear that the bridge was of ample strength, and that the floor system was not bad. Although it was alleged to be instrumental in the accident.] Yet they recommended that the floor system be changed, and that to replace the upper chords with wrought iron or steel would make it more in harmony with recent practice and safer against shock and vibration, if no stronger. The floor system was reconstructed. The second suggestion was not acted upon, although recommended by the constructing engineer independently. How much force was intended to be given it we cannot say at this day.

Now that the second span has fallen with no unusual extraneous cause, apparent or probable attention is forcibly drawn to the cast iron members. Only a few of these are visible, but they appear to be of good metal, except in one instance, viz.: the east down-stream joint box at the head of the end post. Here we find an old shrinkage crack, a blow hole, and a dirty and graphitic fracture. As the break was evidently produced by the fall it has no bearing on the question.

"Shrinkage cracks" are quite numerous about the cast iron chords of the remaining span, and were equally prevalent in the two spans that fell. These are seldom in the body of the chord, but usually in the thinner portion of the metal, at the joint boxes. It is said that these were first noticed or became decidedly apparent after the spans were swung, and that one of unusual magnitude was decidedly about the middle of the down-stream chord of the last span that fell soon after the great cyclone that crossed this span February 27th, 1876.

These shrinkage cracks were not regarded by the constructing engineer as of any moment, and they do not appear to have attracted the attention of the experts called in at the inquest on the first span as a matter worthy of mention. The company apparently regarded them as of little importance, as their attention had been repeatly called thereto.

It would seem from this that they could have no bearing. Still we are inclined to believe that they made the spans no stronger, if no weaker, and we further believe that a thousand such cracks in a span would be a serious matter. Exactly how many may be allowed with safety we are not prepared to say. If these cracks developed or became more prominent when the span was swung, as is alleged, it is possible that, although the cracks themselves might not be dangerous, they indicated an internal stress which was relieved by cracking only to that extent of which this stress and the applied load exceeded the tensile strength of the metal. In such an event, could disintegration gradually progress, and the span fall, and that not necessarily under the maximum loads? Possibly some study of the fatigue of cast iron under such circumstances may throw some light on the subject.

We merely throw out the suggestions for what they are worth. If we are wrong in any of our assumptions we invite correction. If there is a lesson in these disasters it is far too important to be lost, and we hope it will receive as close attention at the hands of competent experts as did the Tay and Ashtabula disasters. The fact that few lives were lost does not alter the public importance of the matter.

The State Railroad Commissioners in their report and recommendation of December 15th, undoubtedly express the popular sentiment. They condemn the remaining through span, and recommend that the cast iron of the Fink spans be replaced with wrought iron or steel, and that they be reconstructed to carry "the same loads the through spans are required to sustain," viz: "with proper margins of safety, the heaviest locomotives." These Commissioners, along with the experts, had previously pronounced the bridge entirely safe.

It is evident that the Wabash designs to undertake every reasonable change to make the structure entirely safe, and restore confidence. We notice that they have called in consultation with C. Shaler Smith, D. J. Whittemore, of the Milwaukee and St. Paul Railway; W. S. Pope, of the Detroit Bridge Company; H. H. Clark, of the Lake Shore Railway; and H. Gottlieb, of the Keystone Bridge Company. It is to be hoped that they will not consider their labours finished until they have presented the profession with a rational explanation of the cause. To allow the belief to disseminate that such things are fortuitous, and to be looked for occasionally, is a curse too great for the profession to bear.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents.*]

OTTO *v.* LINFORD.

SIR,—The assertion of "Fair Play," whose admirable letter, with that of "Nemo," appears in your columns this day, "that a grave miscarriage of justice has occurred, due entirely to the incorrectness and incompleteness of the evidence submitted to the judges," requires explanation at some length to avert unmerited censure. Of incorrectness I will leave the benefit to the other side, or, if the word offend, say the proclivities of scientific witnesses require — to arrive at correct conclusion — that implicit credence should not be given to their testimony. Many misfortunes contributed "to the incompleteness." The elevation of Sir H. Jackson to the Bench a few days before the expected hearing deprived Mr. Linford of his services. A short postponement enabled a brief to be delivered to Mr. Kay, whose appointment in the middle and most critical point of the hearing again was a disastrous loss, for though witnesses were in attendance to complete the defence, the Court being evidently with the defendant, it was decided to leave well alone. It is due also to the defence to say Mr. Linford was urged to make engines 1 and 2 of plaintiff's specification, 2081, that such engines were not made, and that had they been made, as a perusal of the judgment —see ENGINEER, February 3rd—will show, most of the reasons of reversal would have been dealt with. In consultation with Mr. Linford's other advisers it was determined to offer a brief to Sir John Holker in the Court of Appeal, and without undervaluing the services of my leader, I may say Sir John Holker's appointment a few days before the hearing was again a serious loss to my client. That Mr. Otto is not entitled either to the patent upon which the action is brought, or to the benevolent construction accorded to the specification, I think appears upon the evidence, and more so from a subsequent specification. The action was founded upon the first and second claims of patent 2081, 17th May, 1876. The first, "admitting to the cylinder a mixture of combustible gas or vapour with air separate from a charge of air or incombustible gas, so that the development of heat and the expansion or increase of pressure produced by the combustion are rendered gradual substantially as therein described." The second is "for compressing by one instroke of the piston a charge of combustible and incombustible fluid drawn into the cylinder by its previous outstroke, so that the compressed charge when ignited propels the piston during the next outstroke, and the products of combustion are expelled by the next instroke of the piston, substantially as therein described.

The "incombustible" is explained by plaintiff's counsel as being either air or carbonic acid gas. The ignition is by means of an external flame.

Patent 491, 5th February, 1877, granted to N. A. Otto and F. W. Crossley, claims, *i.a.*, first establishing an equilibrium of pressure between the compressed charge in the cylinder and the igniting charge in the slide chamber, pointing to the inefficiency in lighting of an external flame as in 2081.

Patent 2177, 4th June, 1877, granted to F. W. and W. S. Crossley, partly a communication from N. A. Otto, *i.a.*, "dispenses with the stratified condition of the combustible charge, and introduces into the cylinder a uniformly diluted combustible charge." So much for the cushion in 2081. "If such a charge were ignited in the ordinary way," says the specification, "it would take place more slowly than in the stratified condition, and therefore a strong or undiluted charge of the compound is introduced, so that on ignition of this strong charge the resulting flame will be projected with some force, and being brought into extended contact with the diluted charge, will effect the rapid combustion and cause the maximum pressure of the gases to be attained before the piston has performed any considerable part of its stroke." So much for the gradual combustion of 2081.

The fourth claim is, *i.a.*, "to permit the gaseous pressure in the cylinder to be transmitted to the cavity without forcing the igniting flame back up the supply pipe, and preventing ignition." So much for lighting as in 2081. All this was in evidence.

Patent 4927, 31st October, 1880, granted to F. W. Crossley, *i.a.*, provides a pump to discharge air into the space of the cylinder to displace therefrom the residuary products of combustion, and the first claim is forcing air into the cylinder while the products of combustion are being expelled, so that the space of the cylinder behind the piston before the admission of the combustible charge may be mostly occupied by air. So much for the residuum of carbonic acid gas in 2081. So much for the advantage claimed by Mr. Bramwell that the plaintiff utilised carbonic acid gas which Johnson got rid of. Mr. Bramwell admits Johnson's specification of 1860 discloses the pith and marrow of plaintiff's invention, but says it leads away from it because Johnson tells the reader you must get rid of the residuum of previous combustion and replace it by air—exactly what plaintiff does. Thus the plaintiff builds up step by step, upon a false foundation, a useful patent, adopting the views of Lenoir and Linford—the first declared not to be an anticipation, the second to be an infringement—a palpably unfair advantage to Otto, and loss to Linford; though, as was justly urged, there is a far wider difference between Linford and Otto than between Otto and Johnson.

As to the judgment. There are many distinctions between the plaintiff's patent and the patent for the hot blast in iron manufacture referred to by Lord Justice Jessel. The plaintiff's is for improvements in engines—a mechanical title. Neilson's was for improved application of air to produce heat. The improved application of gas and air by the plaintiff is perfectly inconsistent with the title, and the inconsistency is one of very many grounds of objection. Again, the patent is for hot air instead of cold air—something new in application. As Vice-Chancellor Bacon said, the claim of the plaintiff is "for the cam of nature." If the cylinder is longer than the piston the clearance must contain something; that something would be either products of combustion or air, or a mixture of both, all claimed by the plaintiff—call it residuum; if combustible mixture is next admitted it would be behind the residuum; if there be diffusion, necessarily the richest part must be farthest from the residuum and nearest the point of ignition; if diffusion cause gradual combustion, then gradual combustion must ensue — physical conditions impossible to alter, and therefore not the subject of a patent. It all depends upon the difference of length between the cylinder and face of the piston, whether the residuum is notable, considerable, substantial, or otherwise. Johnson's clearance is certainly equal to Otto's, and Linford's is larger than either. This case—Neilson *v.* Harford—is otherwise in the defendant's favour. Baron Park expresses a strong opinion upon a statement of the specification as untrue, and says: If in order to use a patent beneficially at all experiments are necessary, then the specification is void. Surely not making one engine without an improvement the subject of a subsequent patent, as was admitted by Mr. Crossley to be the case, is convincing evidence of necessary experiment, and that engines without that improvement could not be beneficially used and were not marketable for nine months elapsed between the granting of 2081 and the subsequent patent. The thrashing machine error in drawing next referred to in no way affects this action—there the error was apparent. The plaintiff's drawing cannot be altered to effect its asserted purpose, all the ingenuity of Mr. Crossley and his assistants could not produce an efficient slide. Had Lord Justice Jessel, when by mentally enlarging the air-port he thought he had overcome the difficulty psycoptically brought the slide back to the point of ignition, he would at once have seen that precisely the same quantity of air must enter separately last as first. On this point the evidence of Mr. May and Mr. Gardner is conclusive, and that of Sir F. Bramwell is incorrect. Mr. Imray himself says, "What you open first you must close last," and "if air is admitted after the combustible charge it cannot be ignited."

The illustration of brown brandy and water is also not a happy one. Calculating the proportions of explosive gases under compression in a cylinder under varying conditions is surely not so easy as mixing under fixed laws brandy and water in a transparent receptacle. If the brandy were directed to be diffused with part of the water, leaving the remainder intact, so that first drinking the strongest and gradually losing the flavour, one finished with the draught of the cushion of pure water, I could better understand the resemblance, particularly if the fluids travelled one way and were compressed the other 180 times a minute. If it could only be arranged that water expanded by the mixture heated in the stomach sustained the gradual impression of the first strongly impregnated potion, what brandy would be saved and shocks to the system avoided!

The next case quoted as to dye is Renard *v.* Levinstein, in which Lord Justice Bruce, quoting V. C. Wood, said "those who practice an invention are bound to say what they do themselves." The plaintiffs must state the proportions they use, and the effect of the decision as quoted by Lord Justice Jessel was, "they never sold an ounce of dye made according to the patent, but immediately after discovered an improvement and sold the improved dye." Under the circumstances, said his lordship, the mere fact of not selling the original dye was nothing at all. How does this differ from Lenoir—Johnson—his first patent was 8th February, 1860, his second was granted 14th January, 1861, for improvements on the patent of February, 1860. If the decision in Renard *v.* Levinstein support Otto, how can it prevail against Johnson—the conditions being equal. The inference is not justified that because the Lenoir engine was not produced, those made must have been according to the subsequent patent—there were but two, and both in evidence; even if justified it would not affect the case according to the decision quoted, but as a fact, with the greatest deference, the inference was not justified in the face of evidence that though 4000 Otto engines have been made during the last four years, one had to be expressly made to be in accordance with the plaintiff's specification. Lord Justice Jessel himself has said that a machine used for one purpose cannot be patented for any other. I therefore fail to see how Johnson's specification, admitted to describe the pith and marrow of plaintiff's patent, is not an anticipation.

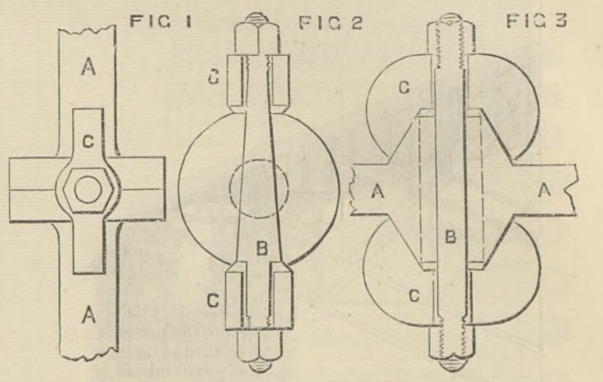
Had Mr. Kay not been made a judge, evidence in attendance would have been called to prove that a compressed charge would blow backwards an external flame and would not become ignited; to explain an indicator diagram to prove that carbonic acid gas in diffusion with weak combustible mixture would prevent explosion; that combustion of gases is uniform, far outstripping in speed electricity; that compression of gases increases and not graduates the speed of combustion; and with many other points of defence. I cannot but regret that any rules exist which compel a judge to decline to know anything when his well-known vast knowledge and scientific attainments if brought to bear would be an inestimable benefit in producing certainty of decision.

For these and other reasons I think the patent upon which the action is brought is bad; that though the evidence was incomplete it was shown to be bad, and that the patentee now utilising the ideas of Lenoir and Linford, favourable consideration is not due to him, and that Mr. Linford is entitled to most cordial sympathy. I have every hope the House of Lords will reverse the decision of the Court of Appeal. I have more than confidence, with the warnings afforded, in any future trial upon fresh grounds the patent 2081 will be declared invalid. CHARLES EYRE,
Rolls-chambers, 89, Chancery-lane, Defendant's Solicitor.
February 10th.

SCREW SHAFT COUPLINGS.

SIR,—I send you the following description of a coupling for screw propeller shafts, designed to provide a remedy against the seaman's dread on board screw steamers; that is, broaching to or falling into the trough of the sea in a gale of wind on the stoppage of the engines. The four-bolt coupling at present in use takes too long a time to disconnect after the order is given, so that before the disconnection can be completed the damage is done of destruction on deck, shipping quantities of water, or foundering.

In the following plan there is only one nut to unscrew; the nut on the opposite or thick end can be used for starting the single long-tapered key, which can then be easily and quickly drifted or



dropped out. Fig. 1 is a top view, Fig. 2 the end of the shaft so fitted, and Fig. 3 a section. The ends of the shafts A A are held together by the nuts on the end of the tapered key B, drawing the V-shaped clips C C down on a corresponding angle on a swell on the shaft behind the flanges at an angle of about 60 deg., the clips holding the two lengths of shafting together and the key making all turn.

I would place such a coupling on the second or third joint from the stern post, and mill or groove on a line with the shaft the edges of the first or second coupling, so that a wooden or iron lever might be used in a suitable fulcrum and guides to hinder the propeller from being jerked round by the sea at the time the key is dropped out. This coupling will want a collar to bear the drag of the screw after disconnection, and a larger passage round it in the tunnel.

With the screw set free a steamer, after the engines are disabled, may be got out of the trough of the sea, or even prevented from falling into it, as a free screw will neither be a drag to prevent the sails on the vessel from gathering headway or yet vitiate the steering qualities of the helm.

With a slight modification this coupling will act as a universal joint within narrow limits, but sufficient to compensate when the line of shafting is out of truth from the vessel straining or other causes, and so avoid one cause of breakage. LOG CHIP.
Gateshead, January 30th.

PILE-DRIVING BY ELECTRICITY.

SIR,—At the present time any successful application or transmission of power by means of electricity cannot fail to interest your readers.

On Thursday last I visited Hatfield Park to inspect a cofferdam made across a portion of the river Lea, the piles to support which were driven by the power of a water wheel situated at a distance, which power was transmitted by two dynamo machines and a couple of wires to gearing connected to a pile-driver of ordinary construction. These were erected on a barge floating in the river. The machinery, although rather roughly constructed by the *employés* on the estate, worked very well, lifting a dolly weighing about 4 cwt. with ease and regularity, which left little doubt that with a few improvements piles of the largest size could be driven by the same means successfully. Such an adaptation may prove of much value in certain situations.

Great merit is due to the energetic clerk of works, Mr. Shillito, for so successfully arranging and carrying out the scheme. The Marquis of Salisbury, who takes a lively interest in electric lighting, as well as in every scientific or mechanical improvement which comes to his notice, has, with the assistance of Mr. Shillito, succeeded in lighting by means of the same water wheel the principal rooms and corridors in the old mansion at Hatfield. The incandescent lamp is used, and the dynamo is about one mile and a-quarter from the house. I found many improvements in details worthy the attention of those interested in electric lighting. F. W. TURNER.
St. Alban's Ironworks, St. Alban's, February 11th.

THE EFFICIENCY OF TURBINES.

SIR,—I have had some experience in the above class of motor while in the office of the late Richd. Roberts, C.E., who patented a turbine in 1852, which was upon the parallel flow principle, and named by him as the "Balance Turbine," several of which were erected and gave very satisfactory results. The rules adopted for constructing these turbines were those adopted by Cullen, to be found in his treatise upon Turbines, which he had found gave the best form for Furoneyron and others.

These rules were slightly modified to suit the Balance turbine. Perhaps your correspondents Messrs. Hett and Turnbull, jun., will kindly state how they arrive at the varied diameters of the turbines they advocate, which would go far to establish in my mind several doubts as to the real efficiency of one turbine over another, provided all the requirements of each particular locality are studied. J. GILLAIRD.
Liverpool, February 14th.

BOWSTRING GIRDERS.

SIR,—I observed in Mr. Lean's letter, which appeared on the 3rd of February, the following:—"For bowstring girders with an odd number of bays these rules will require a slight modification from the fact that if the middle bay of the top flange has its centre in the parabolic curve, the points of intersection of the diagonals with the top flange cannot be in that curve." I should have thought that if the points of intersection of the diagonals were in the parabolic curve with an even number of bays, they would also be with an odd number.

Would Mr. Lean have any objection to pointing out the modifications necessary? G. W. BUCKWELL.
Brighton, 14th February.

PRESSURE IN GRAIN TANKS.

SIR,—Could any of your readers kindly give me the results of experiments—or say where they are to be found—which may have been made respecting the pressure of grain against high walls of tanks, compared with the pressure of water, or favour me with other practical data. A hexagonal tank of brickwork, 76ft. deep by 12ft. wide inside, and 7ft. on each side, has to be filled with wheat weighing, say, 47lb. per cubic foot. In the case of water the total pressure against one side of tank would be 76ft. × 7ft. = 532 square feet area × ½ depth = 38 × 62½lb. = 564 tons. The same formula applied to grain under above circumstances might give approximately accurate results; but on this point I desire reliable information. Also results of experiments which may have been made on transverse strength of brick or stone walls, such as sides of above tank taken as beams fixed at ends. All I can find at present is an experiment on a slate slab, 2ft. 10in. wide, 4in. thick, 4ft. span, breaking weight of which was 24½ tons equally distributed over 15in. of centre of span—see "Britannia and Conway Bridges." Hurst's Multiplier for Welsh slate is 2·5, in above experiment it is about 3. What then is the comparative strength of stone slabs, or strong brickwork in cement treated as beams? J. W. C. H.
Liverpool, January 31st.

RAILWAY MATTERS.

WE are asked to say that the railway fence recently referred to in this column as a new manufacture by Messrs. W. Bain and Co. has, in the essential feature to which we referred, been long known in the trade as the "Corrimony fence."

A COMMISSION of Inquiry appointed by the Governor-General of Algeria has been taking evidence on the question of constructing a line of railway from Algiers to Laghouat; and, according to the *Times*, a sub-commission is now engaged in drawing up a report on the subject. Laghouat is the most advanced place of any importance on the borders of the Sahara.

JUDGING from the severity of the strictures of a Melbourne paper, the Victorian railways and management might be improved. It says:—"Not to speak of graver faults, the carriages are inconvenient, the stations are comfortless, the clerks and porters uncivil, the fares unequal, the luggage arrangements irritating, the refreshments disgusting, and complaints unavailing. Moreover, it says that all the gate-keepers on the line are crippled, blind, deaf, or paralysed—or all four of these."

ON Saturday night a Pulman drawing-room car attached to the Great Northern Railway express from London, due in Leeds shortly after ten o'clock, caught fire while standing in a siding of the Exchange station after the arrival of the train at its destination. The flames were not observed until they had got well hold of the interior of the car, and a great portion of the vehicle was eventually destroyed, the damage being estimated at considerably over £1000. The fire is supposed to have spread from a stove in the centre of the car, in which the remains of a fire were left after the train had been shunted to the siding.

A COLLISION occurred on the 24th December during a very dense fog, between the 5.30 a.m. down passenger train and a down empty coal train, both from Paddington, at Slough station, on the Great Western Railway. Colonel Yolland concludes his report on this accident as follows:—"The train itself was not supplied with a proper proportion of brake-power. Brakes on the engine and tender and two brake vans was not a sufficient supply of brake-power for a passenger train made up altogether of sixteen vehicles, and I think it is certain that if the train had been fitted throughout with continuous brakes the collision would not have taken place."

THE Clerkenwell Vestry have sanctioned the construction of a tramway from the Angel Hotel, Clerkenwell, often erroneously described as in Islington, down Pentonville-hill to King's-cross, which will form a connection with the tramways extending to the City boundary and the north, north-east, and north-west districts of the metropolis. Two companies have offered to do the work, and both have satisfied the requirements of the vestry as to paving, &c. The vestry have intimated their willingness to consider the merits of a proposal made by the North Metropolitan Tramways Company for constructing tramways along the newly-formed Clerkenwell-road.

ON the 10th inst. a number of the directors and officials of the Highland Railway Company witnessed a series of experiments with the Westinghouse brake, over the Waverley route, for the purpose of satisfying themselves as to its efficiency, with a view to its probable adoption on the Highland lines. The train was composed of an engine, with six carriages and a guard's van; and the experiments consisted chiefly in pulling up while running at high rates of speed. The stoppage was repeatedly accomplished in distances of from 300 to 400 yards; on one occasion, in descending a gradient of 1 in 70, at the rate of sixty miles an hour, the train was brought to a stop within a distance of from 500 to 600 yards. Another test was the uncoupling of a part of the train while going at full speed, and the application of the brake. The result was that the latter portion was brought to a standstill almost immediately, while the front part was pulled up within less than 300 yards, notwithstanding that the steam was kept full on.

IN concluding his report on the collision which occurred on the 9th December, near the Manchester Central Station of the Cheshire Lines Committee during a thick fog, Major-General Hutchinson says:—"The speed would certainly have been far more rapidly reduced, and the collision have been mitigated in its results or altogether avoided, had the engine and tender as well as the train been fitted with a quickly-acting continuous brake." It has now been decided to apply air brake fittings to the Manchester, Sheffield, and Lincolnshire Company's engines and tenders, as well as to the vehicles composing the train. The Chester train was forgotten after it had passed out of sight of the signalman at West Cornbrook junction, and this fact, he says, calls attention to the expediency of some means being adopted to guard against this contingency. He suggests that "in cases of this kind, where a train or engine is stopped from fog or other causes out of sight of a signalman, the guard or fireman should be instructed to go back to the signal-cabin, and remain there until the signalman is able to allow the train or engine to proceed."

THE boiler of a heavy goods engine on the Great Eastern Railway exploded shortly after being brought to a standstill near Bury St. Edmunds on Friday last, and became a complete wreck; the driver and fireman were blown upon an embankment, while the guard was blown backwards upon the tender; the explosion occurred in the fire-box. The guard and stoker were conveyed to the Suffolk General Hospital. The driver was able to walk back to the station, but he also was afterwards taken to the hospital. The engine, a heavy goods locomotive, is numbered 385, and was rebuilt at Stratford in 1876. From the position in which it was found after the explosion it appears to have been lifted bodily off the metals, and then to have swerved round into the six-foot so as to foul the up line. The fire-box was blown all to pieces, and the bars, which were scattered about in all directions, were broken up into small fragments. Two of the bogie wheels remained upon the metals, but all the springs and rods were broken, and huge pieces of sheet iron were found scattered about in all directions, heavy portions being picked up seventy or eighty yards away from the engine. The line and the embankment were covered with soot and the ashes from the fire for a distance of forty or fifty yards.

ON the 7th inst. a new tramway locomotive was inspected by Major-General Hutchinson, on behalf of the Board of Trade, for the Wigan tramways, of which Mr. C. H. Beloe is the engineer. The new engine, which is the first that has been constructed by Messrs. Wilkinson and Co., of Wigan, for these tramways, consists of a detached locomotive enclosed in a car, and the following are the principal dimensions:—Length over all, 9ft.; width over all, 6ft. 1in.; length of wheel base, 5ft. 6in.; diameter of wheels, 2ft. 3in.; two cylinders, having a diameter of 6¼in. and a stroke of 9in. The boiler is vertical, and is 5ft. 3in. high, with a diameter of 3ft. 6in. outside plates, which are of B.B. Staffordshire iron $\frac{7}{16}$in. thick. The fire-box is of Lowmoor iron, and has a diameter of 3ft. Area of fire-grate, 7 square feet; number of Field tubes in boiler, ninety-two. The maximum pressure which it is intended to use is 120 lb. per square inch, but the boiler has been tested by hydraulic pressure to 250 lb. per square inch. The exhaust steam is superheated in a jacket fixed to the side of the boiler, from whence it passes into another superheater in the fire-box and escapes through a slightly contracted nozzle into the chimney. Any water from the condensed steam is discharged into a tank under the engine. The feed-water is supplied from a tank, into which the exhaust steam is not admitted. The weight of the engine in working order, including the driver, is 5 tons 14 cwt. The governor not only stops the engine when the limit of speed is exceeded, but reverses the engine and applies a steam brake simultaneously. The line is a difficult one to work, the gradients varying from 1 in 16 on the Canal Bridge approach to long gradient of 1 in 22. All these difficulties were successfully overcome by the engine. There was a total absence of escape of steam and smoke, and General Hutchinson intimated that he would recommend the Board of Trade to issue a licence for its use.

NOTES AND MEMORANDA.

THE *Balarat Courier* says that the Bulli Coal Mining Company has found the lower half of a seam of coal, 7ft. thick, to be baked into a perfect coke. The seam extends over hundreds of acres. The coke has been tried on the tramway motors, and has been pronounced excellent for the purpose.

THE following has been given as a material for fireproofing for wood by the *Chemist and Druggist*:—Take alum, three parts; green vitriol, one part; make a strong, hot solution with water; make another weak solution with green vitriol in which pipe-clay has been mixed to the consistence of a paint. Apply two coats of the first, dry, and then finish with one coat of the last.

RECENT experimental results give the tensile strength of glass at from 2590 lb. to 9000 lb. per square inch, which is higher than Fairbairn's results; crushing strength, 6000 lb. to 10,000 lb. per square inch. According to Mr. Traulionie, of Millville, New Jersey, flooring glass 1in. square and 1ft. between the end supports, breaks under a load of about 170 lb., presumably concentrated.

AT a recent meeting of the Newcastle-on-Tyne Photographic Association, a paper was read by Mr. John P. Gibson, chemist and druggist, of Hexham, in which the author described his successful photography of a flash of lightning on the night of the last July 5th by means of Swan's plates of ten times the rapidity of wet collodion, and backed with red paper to prevent halation. The lens used was an ½in. Ross rapid symmetrical with the largest stop but one.

HERR DITTMAR'S method of solidifying petroleum consists in heating it in a still to 100 deg. with 2 or 3 per cent. of soap. Vinegar is afterwards used to liquefy it. The method and results were unfavourably discussed at a recent meeting of the Russian Technical Society, St. Petersburg. It was said that the solidification was not perfect, and that oil leaks out of it which would saturate the proposed wood cases for transport and give off vapours; that the cost for soap would be considerable, and that large liquefying works would be required, and finally that the cost of the processes would not be covered by reduction of cost of carriage.

A PAPER has been read before the Paris Academy of Science on the barometric height of January 17th, 1882, by M. Renou. This on the Parc de Saint Maur (alt. 49·30 m.) at 10 a.m. was 782·13 mm.; reduced to sea-level, 786·92 mm. During nearly a century there has only been one height slightly exceeding this at Paris Observatory. On February 6, 1821, at 9 a.m., the height was 780·90 mm., at sea-level, 787·52 mm. It would appear that at Paris during two centuries, with exception of the figures in 1821 and 1882, the barometer has never exceeded 778·5 mm. M. Renan gave an explanation of the recent high pressure. M. Faye attributed to the pressure a remarkable depression of the sea-level observed at Antibes (in the south of France), about which M. Naudin had written him. It lasted a fortnight.

DISTILLERS' wash, which has hitherto been a source of annoyance, polluting watercourses, or rendering the soil putrescent, has been turned to account by MM. Gaillet and Huet, for the production of a valuable artificial manure. The wash, according to the *Journal of the Society of Arts*, immediately it leaves the still, is treated with perchlorate of iron, after being agitated with lime water. The lime precipitates the sesquioxide of iron, the ferric precipitate taking up nearly all the organic matter. The wash thus becomes a perfectly clear, colourless, and innocuous fluid. The deposit or precipitate is agglomerated into cakes, and forms a manure very rich in nitrogen and phosphoric acid, which more than pays the expenses of the process. Little space or labour is required, most of the operations being performed automatically.

THE peppermint crop of the United States has, for the last few years, reached the amount of 70,000 lb. per year, of which about 30,000 lb. were annually exported. Two-thirds of the peppermint oil of this country is produced in New York State, and about one-third in Michigan. The best oil comes from Wayne County, New York. The plant is a perennial one, and is planted in the spring. The next year it is ready for cutting, and generally may be cut for three years. The best yield is given in the first and second year of cutting; in the third year the plant becomes bitter. After the plant becomes four years old it is not cut, and the field is ploughed over and a new crop planted. The usual method of planting is in rows, and in August the plant is ready for cutting, which is done by mowing down with a scythe. The leaves are then placed in a still and the oil is extracted. The plant is a very hardy one, and will yield from 10 lb. to 30 lb. to the acre. The "Journal" of the Society of Arts says that the cultivation of the peppermint is now being introduced into the Southern States.

THE results of a third year's observation of spirit-levels at Secheron, for elucidation of periodic movements of the ground, to which we have several times referred, are given by M. Plantamour in the December issue of *Archive des Sciences*, and Col. von Orff also communicates results obtained at the Observatory of Bogenhausen—three to four kilometres from Munich. M. Plantamour shows that the oscillations, both in the east-west and north-south directions, present anomalies, or differences from year to year, which cannot be explained by mere variations of the temperature of the air. The earth's surface he supposes to be in a state of constant gentle undulation, the direction and amplitude of which varies in each locality according to the nature of the ground and the forces in action; and the effect may strengthen or neutralise that of the air temperature on the ground, or even produce a movement in an opposite direction. Col. von Orff's observations, *Nature* says, afford ground for supposing that the spirit-level variations are, partly at least, caused by variations of heat in the formation on which the Observatory rests.

ON a recent occasion Dr. Grant, of Glasgow, gave an interesting summary of the present state of the science of meteorology. In the course of his remarks he said:—"The Meteorological Office, originally a branch of the Board of Trade, commenced its labours in 1868, the council of scientific men under whose direction it is conducted being nominated by the Royal Society. There are three leading objects which the council have kept in view since 1868. These are:—(1) Ocean meteorology; (2) land meteorology of the British Isles; (3) weather telegraphy. Seven observatories have been established in connection with the Meteorological Office with a view to the advancement of the land meteorology of the British Isles. These are the observatories of Valentia and Armagh in Ireland, Falmouth, Kew, and Stonyhurst in England, and, finally, Glasgow and Aberdeen in Scotland. The observations at each of these observatories are all obtained by means of self-recording instruments, and the tabulated results are regularly transmitted once a week to the Meteorological Office in London. The variations of the barometer and of the dry and wet bulb thermometers are recorded continuously upon paper by a photographic process which goes on night and day without intermission. The velocity of the wind is measured by Dr. Robinson's anemometers. The mean hourly velocity of the wind for the three years 1874-5-6 was:—for Armagh, 10·6 miles, 10·0 miles, and 9·8 miles; for Kew, 10·3 miles, 10·8 miles, and 10·8 miles; for Stonyhurst, 10·8 miles, 10·9 miles, and 10·7 miles; for Glasgow, 12·9 miles, 12·1 miles, and 12·4 miles; for Aberdeen, 13·3 miles, 13·5 miles, and 14·2 miles; for Falmouth, 16·8 miles, 17·0 miles, and 17·4 miles; finally, for Valentia, 18·2 miles, 17·7 miles, and 17·9 miles. During the last two or three years as many as 75 per cent. of the storm warnings which have emanated from the Meteorological Office have been thoroughly successful. During the storm of Friday, the 6th ult., Osler's anemometers recorded a pressure of 51 lb. on the square foot, and yet it bore the strain admirably. During the great snowstorm which swept over London and its neighbourhood on the 18th January, 1881, the Osler anemometer at the Royal Observatory, Greenwich, registered as high as 51 lb. on the square foot."

MISCELLANEA.

THE oil-wells of Petrolia, in Western Ontario, have lately shown signs of "giving out."

SEVERE earthquake shocks have recently killed a large number of people in China, and done much damage.

THE Chinese authorities gave the public free use of the telegraph lines for a month when these were recently opened.

GAS-LIGHTING on the Welland Canal is discontinued. On the opening of the new canal, electric-lighting will be employed.

THE *Broad Arrow* says there is good reason for believing that the scheme for the establishment of a depôt under the localisation system for artillery at Great Yarmouth will be carried out.

THE Rhine has now reached the lowest level of the present century, being at Mayence several inches lower than in 1857. From the bridge the bottom is visible in the middle of the stream.

HASTINGS'S Gas Works statistics show that while the coke from some gas works as at Leeds realises but 4s. 6d. per ton, it reaches 25s. at a small place such as Arlesford, but a common price is from 10s. to 14s. per ton.

THE Engineers' Annual and Almanac for 1882, published by D. M'Gregor and Co., Glasgow, and by others, contains as usual a great deal of information which makes it a very useful pocket book in the engine room.

THE Clarendon press will publish shortly a "Treatise on Rivers and Canals, relating to the Control and Improvement of Rivers, and the Design, Construction, and Development of Canals." By Mr. L. F. Vernon-Harcourt, M.A., C.E.

AN interesting lecture on the use of gas as a workshop tool, delivered by Mr. T. Fletcher, F.C.S., on the 1st inst., is published at the *Warrington Guardian* office. If amplified with descriptive particulars and illustrations it would be very useful.

THE Common Council Chamber of the Guildhall is at present undergoing the operation of the application of new ventilating apparatus. Messrs. R. Boyle and Sons are fitting the chamber with their "air pump" ventilators, and have guaranteed success.

THE report of the directors of the Phosphor Bronze Company states that the success of the "Phosphor Bronze," a launch of which we have given some particulars, has encouraged them to build a larger vessel, and they have just concluded a contract with a first-class firm for the construction of a 60ft. phosphor bronze boat for sea-going purposes and Government service.

RECENT advices from Shanghai confirm the statement made some time since in this column, that the Woosung Bar off that place is to be dredged out of existence. A double hopper dredge, capable of raising 300 tons per hour from a depth of 30ft., has been ordered and when the barrier has been removed it is expected that largest steamers will be able to run alongside the jetty.

MESSRS. VACHER AND SONS, of Parliament-street, are publishing, free of cost, a pamphlet by Mr. P. W. Barlow, F.R.S., C.E., in which he gives an explanation of what is stated to be a fact, namely, that by excluding the air from under a fire by a plate or tile it will produce much greater heat arising from more perfect combustion of the smoke and coal, and, in addition, produce better ventilation of the room.

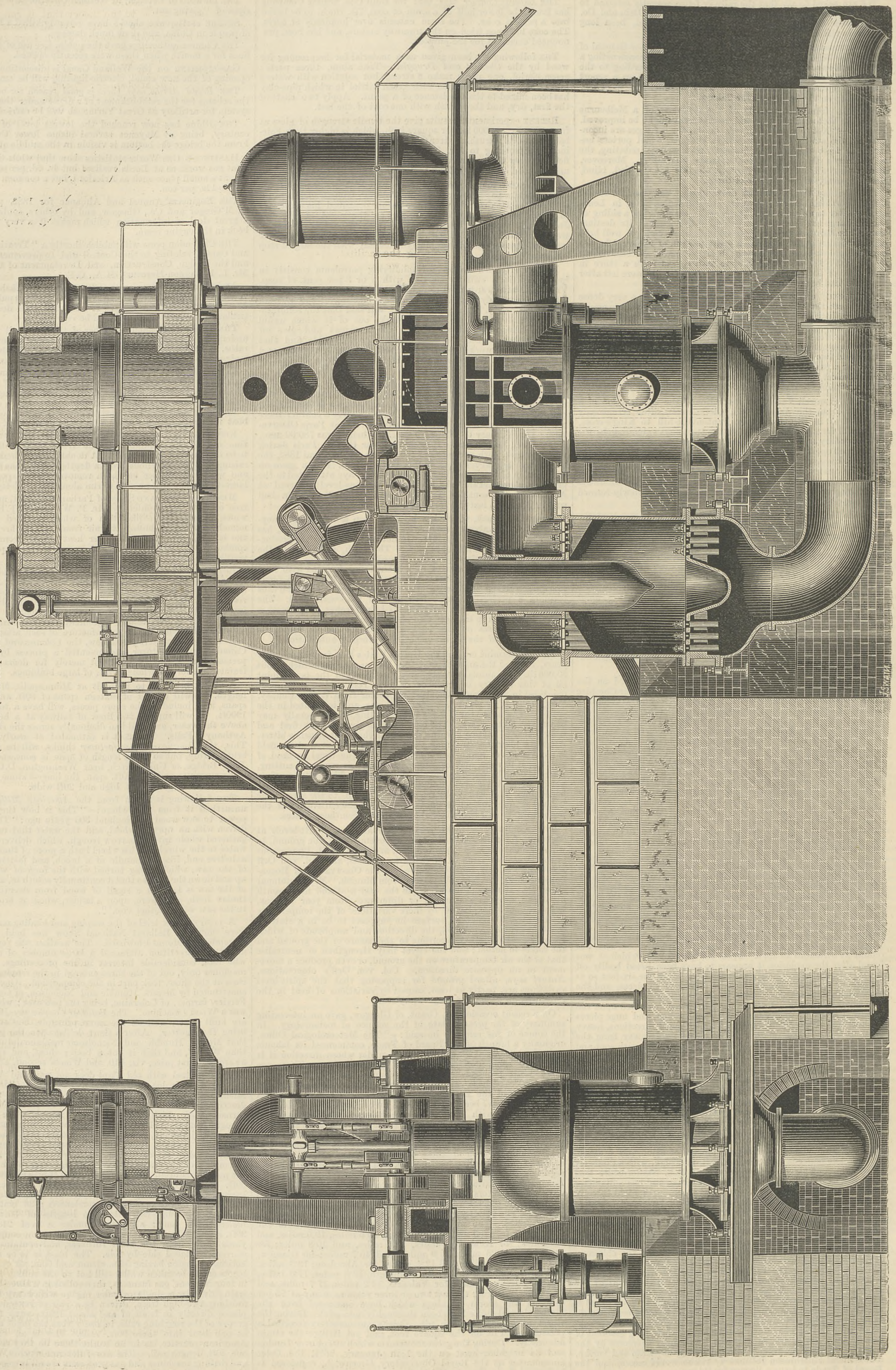
BOTH cotton and paper are being employed for building purposes. Compressed paper pulp is successfully used in the manufacture of doors wall-panellings, and for other similar purposes, with the result that all risk of warping and cracking is obviated, while increased lightness is attained, and dry rot avoided. Celluloid, in which cotton is the leading ingredient, has been used lately as a substitute for ivory in the manufacture of such articles as billiard balls and paper cutters; and now, the *Colonies and India* says, a Canadian manufacturer has invented a process by which compressed cotton may be used not merely for doors and window-frames, but for the whole *façade* of large buildings.

A STONE bridge is to be built at Minneapolis, Minn., of great length. It will consist of sixteen spans of 80ft. and four 100ft. spans, and, including the shore pieces, will have a total length of 1900ft. It will support two lines of railway at a height of 60ft. above the water, and will run diagonally across the river below St. Anthony's Falls. The cost is estimated at nearly 500,000 dols. This, the *American Manufacturer* thinks, will be a remarkable bridge, truly, but so far as length of span is concerned the Cabin John Bridge, or Union Arch, near Washington, D.C., exceeds it, being a granite arch of 220ft. span, the longest stone arch in existence. The bridge is 101ft. high and 20ft wide.

THE following is taken from the *American Miller*, which has unearthed it from somewhere:—"This is how they used water power to saw wood in England 300 years ago: 'The sawmill is driven with an upright wheel, and the water that maketh it go is gathered whole into a narrow trough, which delivereth the same water to the wheels. This wheel hath a piece of timber put to the axle-tree end, like the handle of a broch, and fastened to the end of the saw, which, being turned with the force of water, hoisteth up and down the saw, so that it continually eateth in, and the handle of the saw is kept in a rigall of wood from swerving. Also the timber lieth, as it were, upon a ladder, which is brought by little to the saw with another vise.'"

A COMPETITIVE trial of the reaping and binding machines which were shown at Ballarat National Show was held on the 30th December, at Mount Blowhard. The weather was very favourable, and the competition attracted a large number of agriculturists, who took considerable interest in the proceedings. Two of the machines only, out of the three entered in the reaping and binding class at the show, took part in the competition. One of them was constructed by Messrs. Humble and Nicholson, of Geelong, Mr. J. Ferrier, farmer, of Coleraine, being the patentee; while the other was a Wood's machine. The *Ballarat Courier* says, both machines are built pretty well on the same principle, the only difference being the knotter. After a short deliberation the judges decided that Messrs. Humble and Nicholson's machine did its work tidier than Woods', and that it cut a better sheaf, and therefore they awarded it first prize, viz, £10, and Woods' second, £5.

MAKING steel with old plant does not pay, and Americans are putting down a lot of new plant. At South Chicago, on Lake Michigan shore, a completely new plant of the most modern description is almost ready for work. It consists of four blast furnaces, 75ft. high, 21ft. bosh, 9ft. hearth. The coke used is brought from Connelsville, near Pittsburgh, distant some 450 miles. The ores, limestone, and coke are stacked in a fine roofed shed 367ft. long by 98ft. 10in. wide. To save re-melting, the molten metal is taken direct to the converters. So far in America their attempts in this direction have failed, owing to the inequality of the metal produced. There are fourteen Whitwell fire-brick stoves, 60ft. high, 21ft. diameter; eight vertical condensing blowing engines with 84in. air cylinders, 36in. steam, 54in. stroke, 30 to 35 strokes per minutes; separate condensers; 36 boilers, 4ft. diameter, 72ft. long, cut into two lengths of 36ft. making 72 boilers 36ft. long; all placed under a roof 248ft. long by 96ft. span. The converting house is about some couple of hundred yards away from the blast furnaces, and contains three 10-ton converters placed side by side. The blast is to be supplied by a horizontal engine having 54in. steam and 60in. air cylinders. The ingots are to be taken whilst still hot to the rolling mills; heated in four Siemens' gas furnaces, then rolled in a three-high roughing train driven by a single cylinder engine with heavy fly-wheel. A finishing two-high train, driven by a pair of reversing engines, is placed directly in front of and about 120ft. away from the last groove of the roughing rolls, in order that the ingot may be rolled at one heat into three 30ft. rails. This is an experiment in American practice, as in no works there do they roll more than one 30ft. length rail. The saws, hot rail-benches, straightening and drilling machines and gas producers are all in good substantial buildings well roofed in.



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(For description see page 115.)

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TO CORRESPONDENTS.

**** In order to avoid trouble and confusion, we find it necessary to inform correspondents that letters of inquiry addressed to the public, and intended for insertion in this column, must, in all cases, be accompanied by a large envelope legibly directed by the writer to himself, and bearing a 1d. postage stamp, in order that answers received by us may be forwarded to their destination. No notice will be taken of communications which do not comply with these instructions.*

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E. W. W. (Nottingham).—*P. S. King, King-street, Westminster.*

ART WORKMAN.—*We believe that any copper-plate printer will get the work done for you. Mr. Brooker, of Margaret-street, W., could help you.*

AN APPRENTICE.—*The tubes in surface condensers are commonly ⅝in. diameter. In some cases the water is passed through the tubes, and in others outside the tubes.*

T. T. (Southampton).—*"A Practical Treatise on Mill Gearing," by T. Box. London: E. and F. N. Spon. "Mills and Millwork," by Sir W. Fairbairn. London: Longmans and Co. "Machine Drawing and Construction," by Tomkins. London: Collins, Son, and Co.*

E. AND H. R.—*We regret that we cannot name any particular work on prime cost as specially suitable for your purpose. There are, however, a considerable number of books on the subject, some of which have been advertised in our columns. Your best plan would be to communicate with the authors of some of these, and thus ascertain if any of them would suit you.*

J. W. B.—*We cannot find the formulæ you quote in any work on valve gear in our library. Taken as they stand, without the context, they are unmeaning. Do they apply to valves worked by a simple excentric, or to link motions? If you can refer to Zeuner's "Treatise on Valve Gear" you will find the whole question exhaustively dealt with—page 28 et seq. If you will refer us to your authority we will endeavour to answer your question.*

THE CORINTH CANAL.

(To the Editor of The Engineer.)

SIR,—Allow me to ask through your columns for the name of the contractor for the Isthmus of Corinth Canal. A. W.
London, February 14th.

CEMENT MAKING BY THE DRY PROCESS.

(To the Editor of The Engineer.)

SIR,—I will be glad if any of your readers can give me the address of any works in England which are making cement by the dry process.
D. M.

WINDMILLS.

(To the Editor of The Engineer.)

SIR,—Can any of your readers give me the title and publishers of a practical work on windmills, concerning their construction and management? SUBSCRIBER.
Lowestoft, February 14th.

IRRIGATION.

(To the Editor of The Engineer.)

SIR,—Can any of your readers supply me with the name or names of best books or papers on the subject of irrigation as carried out in India for the purpose of watering the plains? SURVEYOR.
Middlewich.

CENTRIFUGAL SUGAR-DRYING MACHINES.

(To the Editor of The Engineer.)

SIR,—Of the various designs of these, English, French, and American, now before the public, can any of your correspondents tell me which is the most easily managed machine and most economical sugar dryer, also giving particulars and prices of same? G. G. D.
London, February 15th.

SOFT IRON FOR ELECTRO-MAGNETS.

(To the Editor of The Engineer.)

SIR,—Can any of your correspondents say where I can find the recorded results of experiments to find the relative efficiency of soft wrought iron, soft cast iron, and also of malleable cast iron for the purpose of making electro-magnets? I know that cast iron is used for the field magnets of two different dynamo-machines, but I want to know whether the soft malleable cast iron, or ordinary soft cast iron, will do as well as soft wrought iron for small electro-magnets. YBROW.
London, February 15th.

OLD BRASS FOR BEARINGS.

(To the Editor of The Engineer.)

SIR,—Would any of your numerous readers help me out of the following difficulty? I get a quantity of old brass, some very light and some old mill brasses, of which I make some very fair bearings for general machinery, but I often get castings badly drawn and full of specks and holes. I have somewhat prevented the drawing by putting in a little zinc, but cannot find any means to prevent the specks and blow holes. If some of your kind readers would help me they will greatly oblige AN OLD SUBSCRIBER.
Gloucester, February 11th.

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Feb. 21st, at 8 p.m.: Paper to be discussed, "Air-Refrigerating Machinery and its Applications," by Mr. Joseph James Coleman.

SOCIETY OF TELEGRAPH ENGINEERS.—Thursday, Feb. 23rd, at 8 p.m.: "Siemens' System of Railway Gong-Signalling," by R. Von Fischer Treuenfeld, Member.

SOCIETY OF ARTS.—Monday, Feb. 20th, at 8 p.m.: Cantor Lectures, "Recent Advances in Photography," by Captain W. de W. Abney, F.R.S. Lecture IV.—Permanent printing processes. Application of photography in drawing. Mechanical printing processes, including photo-engraving. Wednesday, Feb. 22nd, at 8 p.m.: Twelfth ordinary meeting, "The Production and Use of Gas for Purposes of Heating and Motive Power," by Mr. J. Emerson Dowson. Thursday, Feb. 23rd, at 8 p.m.: Applied Chemistry and Physics Section, "Methods and Standards of Photometry," by Mr. Harold B. Dixon, M.A.

THE ENGINEER.

FEBRUARY 17, 1882.

THE CHANNEL TUNNEL.

THERE is something partaking of the ludicrous about the dispute now raging concerning the military aspect of the Channel tunnel scheme. Sir Garnet Wolseley takes just the same view concerning the facilities for invasion which the tunnel would offer as we have done. A commission has been appointed—shall we say by the Government?—to consider and report on the subject. As eminent an authority as Sir John Adye holds that the Adjutant-General is wrong; and we learn that it is the intention of the Government to appoint another and larger Committee to take evidence from distinguished military men and others in relation to the proposed Channel Tunnel. The Committee is to be appointed at an early day, and the whole subject will be fully inquired into before Parliamentary powers are granted for the construction of the tunnel. The daily press has taken different sides, and the possibility of seizing the Dover end of the tunnel; the number of troops which could be transported through it per hour; the feasibility of blowing up the English end, and dozens of similar ideas are talked and written about with all the energy and bitterness imaginable, just as though the tunnel was to be opened for traffic in a couple of months, and well prepared schemes existed for working it. There is an old proverb about counting chickens before they are hatched. In the case of the Channel tunnel the chickens are being counted before an egg has been laid. Nothing can better serve the purpose of the promoters of the scheme than a discussion which keeps it before the world; and it seems a pity that any countenance whatever, official in character, should be lent to what is nothing more than a crude, inchoate, proposal. So long as the public refrain from investing money in the scheme all will be well; but we much fear that shares will be taken, and that shareholders will find too late that they have played the part of fools. We contend, and we shall continue to contend to the last, that the promoters of this scheme are bound to show how the tunnel is to be ventilated and worked after it is made. If the tunnel was complete only half the work would have been done. Traffic must be carried on through it, and this traffic must be made to pay or the shareholders will lose their money. Nothing is easier to say than that if the tunnel is made it can be worked. Yet easy as it is to say this, not a single syllable concerning the method of working it has been said by any responsible authority advocating the scheme. The reason is simply that no scheme for working it has been proposed, and no scheme can be proposed, because it is impossible to work traffic through the tunnel save under conditions of cost which would be fatal to its commercial success.

There are three ways in which trains can be moved through the tunnel. They can be drawn by ordinary locomotives; or by compressed air engines; or by Lamm's locomotives. There are two ways in which it is imagined trains may be worked, namely, by electricity and on the atmospheric system. We propose here to consider the chances of success which attend these various schemes, and we shall deal with the last two first, because they are easily dismissed. It may be taken as proved that 300 indicated horse-power will be required to work a passenger train through the tunnel in half an hour. Now 300-horse power represents 9,900,000 foot-pounds per minute, or, for the half hour, 297,000,000 of foot-pounds. There is but one way in which it appears to be likely that electricity could be applied. That is by fitting up colossal dynamo-electro machines at one end of the tunnel, and carrying conductors through to drive a motor attached to the train. We shall not say that it is impossible to do this, but we confess we entirely fail to see how twenty miles of conductor can be efficiently insulated in a damp tunnel. It must not be forgotten that the electrical current used must have considerable intensity, and will therefore be readily wasted; just as high-pressure steam is more readily lost through leaks in a pipe than is low-pressure steam. Few electricians have committed themselves to say this thing can be done; and it is obvious that very great difficulties will have to be overcome, even on paper, before a rational scheme for doing it can be prepared. It has been suggested, however, that the trains can be worked by storage batteries, such as Faure's. If we assume that wonderful improvements will be made, and that storage batteries weighing 100 lb. can be produced, each of which will give out 2,000,000 foot-pounds of net useful effect, in round numbers 150 such batteries must be carried by each train. The weight of these batteries would be over 6 tons; the time required for charging them would be, say 20 hours, so that a large reserve of batteries would be needed. Let our readers try to imagine the staff and the plant that would have to be maintained to keep the traffic going without interruption. Need we say that no electrician has even attempted to give a numerical statement concerning the working of this scheme; we may dismiss it as unworthy of serious attention. It may be urged, of course, that before the tunnel is complete such changes and improvements will have been effected that electricity can be readily used for the required purpose. We admit that this is possible; we altogether deny that it is probable. A great deal is known about the dynamics of electricity, and all that is known is unfavourable to the theory that it can become a great and cheap motive power. At all events, there is nothing about the crude proposals which have been made for working the tunnel traffic by electricity which will justify a promoter in going before the public and stating that the traffic can be worked at all, much less economically, by electricity. The atmospheric system may be dismissed as equally futile. The power required to maintain a current of air moving at the velocity of but twenty-four miles per hour would be 15,000 horses. It will be seen that to haul a train on the pneumatic system—that is the train playing the part of a close piston moved by the pressure of air behind it—would be out of the question, and it is equally certain that the tube system, such as that used on the Dalkey and Kingstown line of two miles long, is not to be thought of. The loss by leakage through the continuous valve was enormous even for two miles, to say nothing of the frictional resistance of the column of air within the pipe.

Only three schemes remain then as deserving consideration. The first is to work the tunnel with ordinary locomotives, as the Metropolitan Railway is worked. But to do this ventilation must be maintained at the rate of twenty-four miles an hour. The whole subject has been fully discussed and thrashed out. Our readers will find all the data in Simms' "Practical Tunneling," by Clark. Power equal to 15,000 H.P. indicated must be provided for this purpose. No one knows how it is to be applied, or what species of fans or pumps would have to be employed. The fuel burned would, on the most moderate estimation, reach 30,000 lb. per hour, in which time four trains could traverse the tunnel. This gives 80 train miles, and 375 lb. per mile, or at least ten times as much as would be required for the locomotives working the trains. Coal at Dover costs about 20s. per ton, thus the bare cost of fuel for ventilation would be £13 8s. per hour, or say, 3s. 4d. per train mile. The trains would probably weigh 150 tons. On the Metropolitan Railway the cost of fuel is 1½d. per train mile, the trains weighing 150 tons. What possible prospect of paying could a line of railway enjoy, the working of which cost 3s. 4d. per train mile for fuel alone? Rejecting ordinary locomotives, we have left Lamm and Franq's fireless engines; and compressed air. There is no reason to conclude that a Lamm engine could work with less than 30 lb. of steam per horse-power per hour, or for 300-horse power, 9000 lb. of steam, or for the half hour's run 4500 lb. of steam. If we suppose the engine started with a pressure of 200 lb. and ended with a pressure of 100 lb., the fall in temperature on the run would be 54 deg. Each pound of water in the boiler would surrender this much heat, which would be available for making steam; but 30 lb. of steam at an average pressure of, say, 150 lb. would require $861 \times 30 = 25{,}830$ units, and $\frac{25{,}830}{54} = 478$ in round numbers. In other words, for each horse-power to be exerted for one hour the reservoir must hold 478 lb. of hot water, or, assuming that the run lasts half an hour, it must contain 239 lb., and $239 \times 300 = 71{,}700$ lb., or 32 tons of water. The vessel or vessels which contain this body of water under a pressure of 200 lb. on the square inch will weigh a good deal. So it may, we think, be safely assumed that the dead weight conveyed by each train will be almost equal to that of two ordinary tank engines, which would, under usual conditions, suffice to work the trains. Need we add that no engineer has designed a fireless locomotive which would work the Channel tunnel? The cost of such machines, their great weight, the risk incurred in using them, the expensive plant required for charging them, have all told heavily against them even for tramway purposes—for which they have been extensively tried—and we are not aware that even one is now running. In practice it has been found that 1·5 tons of hot water are required to haul 11 tons of train at eight miles an hour. Therefore to haul a 150 ton train at the same speed, 20 tons of water, in round numbers, would be required. The initial pressure in this case was 180 lb., and the terminal only 40 lb., the distance traversed under ten miles. If the speed be quadrupled, the resistance would be at least trebled, and although the time of traversing the twenty miles of tunnel would be only half-an-hour, instead of one hour, during which 1·5 tons of water sufficed for the tram-car whose performance we cite, it is evident that our estimate of 32 tons of water is far below what would in all probability be really required. If our readers will turn to the "Proceedings" of the Institution of Mechanical Engineers for 1879, No. 5, they will find further information on this subject. The last motor on our list is compressed air. If anyone is sanguine enough to believe that this will solve the problem, let him turn to the "Proceedings" of the Institution of Mechanical Engineers for 1881, No. 4, and read Mr. Scott-Moncrieff's paper "On Compressed Air Engines for Tramways," and the discussion thereon. Here it will suffice to say that experience with them has been limited to runs of about seven miles. Air at a pressure of 1000 lb. on the square inch being used, the cost for fuel is stated to be ½d. per mile for 7 tons moved—forty passengers being carried at about six miles an hour. There is a long step between the little tram-car engine and the machine able to haul a train of 100 tons besides itself through the Channel tunnel at forty miles an hour.

Thus, then, it will be seen that while no attempt has been made by the promoters of the two Channel tunnel schemes now before the public to prove that it can be worked at a moderate cost, the truth is that the greatest difficulty will be experienced in working trains through it at all. That two or three trains per day might be run with ordinary Metropolitan locomotives is likely enough. But it is not traffic of this kind that Sir Edward Watkin, for example, contemplates. No one in their senses would, we suppose, dream that the tunnel was to be made unless it was to be worked up to its full capacity. We repeat that it is of vital importance that a rational scheme for working the tunnel should be placed before those who are asked to contribute their money to its construction, and until this information is forthcoming not one shilling should be subscribed to carry out a scheme which is radically incomplete, even on paper.

TIDAL POWER.

THE utilisation of the power which exists in the rise and fall of the tide has long been a favourite scheme with projectors, but its application hitherto has been of very limited character. The introduction of electric lighting, and the demand which it creates for some economical motive power, seems likely to give an impetus of a practical character to the various proposals, which have hitherto been only discussed, for rendering available the natural force which now lies waste along our shores. Great Britain, from its insular character, possesses advantages for the development of that force which countries possessed of a less extended coast line cannot possibly have, and now that a demand exists which will repay the outlay necessary to secure that development, we may expect to see rapid strides in this direction.

Attention has been called to this subject very prominently during the last few weeks by the announcement that the Corporation of Bristol had passed a vote to secure the advice of some eminent engineer as to the best method of developing the power which the great rise and fall of the tide in the rivers Severn and Avon affords, with the object of employing it for the manufacture, so to speak, of the electricity required for lighting the city. It is manifest that that object has only a collateral relation to the subject of this article. It is, in fact, only the immediate inducement to undertake the conservation of a power which may ultimately extend its useful purpose in many other directions. Secondarily, however, electricity may be the agent by which power so obtained may be transmitted, almost unreduced, to great distances inland from the source of supply; but to that branch of the matter we do not intend at present to devote ourselves, deeming it sufficient to point out how extensive the use of electricity may become in the future to aid in the full distribution of that tidal force which is the proper subject of our article. All who are acquainted with the rivers Severn and Avon and the Bristol Channel will at once realise how powerful an agent its tidal rise and fall of from 35ft. to 40ft. must be. In such a case as this there can be but little difficulty, we should say, in the construction and erection of machinery by which the power of the water column may be utilised. It must, however, be borne in mind that the action of the current engendered by a rising and falling tide is slow, and that its power, if exerted on a limited mechanical area, would therefore be but small. Neither can the head of water obtainable be utilised after the methods common in cases where the supply at the summit is constant and the discharge free from back pressure. In the utilisation of the tidal column the head will be constantly decreasing, and any machinery erected must be capable of working under gradually decreasing head, and there will be besides no free discharge at the base of the well in which the turbine must be set.

A cursory examination of this subject discloses that there are considerable, though certainly not insuperable, difficulties to be overcome in dealing with the force of the tide after the manner customarily employed with hydraulic motors. The chief consideration which must enter into any design which has this object must be the means whereby the water passed through any such machinery can be got rid of, for it is manifest it cannot be returned to the source of supply immediately on its quitting the machine upon giving motion to which it has expended its power. But one course seems to us to be open for overcoming this difficulty. We would suggest that only a portion—say five-sixths—of the total column should be employed, and that the discharge water from the turbine should be led by pipes to some impounding reservoir on waste land situate slightly above the level of low tide, from which its re-discharge into the river would be insured at low water. Of course the direct use of head water will only be possible in cases where the rise and fall of tide is very considerable. Where it is so, it is not impossible that the plan we have suggested might be carried out without having to incur anything like a prohibitory expense.

The obstacles to be overcome in cases of extreme range of tides, are not, however, numerous, except under a few local adverse circumstances. Other and more difficult cases will occur in localities where the tide is of too limited a rise and fall to admit of static pressure being economically employed, such as exist on all our sea shores and the majority of our rivers. As regards the last-named, it will be practicable in some few cases to erect dams across these beds and utilise the limited head so obtained in a variety of ways. But there must be many rivers where this will be impracticable for very cogent reasons; for such, and in all instances of sea-tides, it seems to us that the old principle of the race will have to be resorted to. On the rising of the tide, water might be admitted through sluices to an impounding reservoir, the lowest level of which must be above low-water level, and action would be imparted by it for a portion of the period of influx to the reservoir, to undershot wheels or turbines in the races or sluice channels. At the bottom of the tide, efflux would take place through the sluices, producing a reversed action on the machines. It will be patent, that to secure any considerable amount of power with the limited head of water which would be available in such cases, a large volume must be employed, and the necessary machinery would be large and costly.

Our remarks will have shown that the subject divides itself from natural causes into three distinct classes of operation:—First, that of extreme range, where two or more turbines might be used throughout, say, three-fourths the time of each tidal rise and fall; secondly, that of rivers which permit of the head waters being dammed back; and, thirdly, that of rivers where the latter course is not practicable, and which have a limited tidal range—in which class also may be included works to utilise the tide of the sea on open shores. It is further to be observed that in the majority of instances within these islands, such as are those included in the first and third classes, it will only be practicable to employ the tidal power when the conformation of neighbouring land enables it without much artificial improvement for the purpose to receive during the intervals of rise and fall a sufficient storage of water, by the passage to and fro of which the required power may be obtained; but we should say that there are many important towns on our shores, and by the side of our rivers, where such land might be obtained within limited distance, or which might be fitted by excavations at a reasonable cost. We have purposely refrained in these suggestive remarks from going into the details involved in this important question, and have simply touched upon the chief ideas which occur to anyone when thinking over a matter which may become of great national importance.

SIR WILLIAM ARMSTRONG ON NATIONAL DEFENCES.

WE recently gave the presidential address of Sir William Armstrong, which was entirely devoted to the question of national defences. We cannot let it pass, without making a few remarks on so important a subject thus brought before us, although the address embraces too many branches to follow it at all in detail. The first part of it deals with the general question of defence; the latter chiefly with ordnance. With regard to the latter, we simply commend it to our readers as a masterly summary of the question written in a fair spirit. It would be impossible to follow it through its course here, but we may call attention specially to the mention of the steel riband gun, briefly described in THE ENGINEER of July 29th, 1881, and to the remarks on the action of powder-gas in a gun. Two points noticed by Sir William we think deserve special consideration—one the question of the temperature reached by the gas and its effect, and the other the possibility of dispensing with sulphur in powder, with a view to saving the bore from the erosion which so rapidly injures it at present.

To turn then to the general question. Sir William considers that in late years our ships have become more and more open to injury from an enemy in proportion as our commerce has increased, as steam has come in, and as the power of rifled guns has become perfected in a higher degree. Armour has imperfectly coped with the power of guns, and the measure of security it offers has been rendered liable to be unavailing owing to the introduction of torpedoes. In short, powers of offence have so far outstripped those of the defence, that Sir William advocates the use of swift unarmoured ships armed with powerful guns, rather than an exclusive reliance on armour-clads. He considers that three unarmoured vessels might be made for the same cost as one armour-clad ship carrying guns of equal power, and he thinks that pitted against one another in a fight, the three would have a great advantage over the one. He would make unarmoured ships proof or nearly proof against sinking by means of partitions, and would so utilise their coal, and so construct them with regard to the water line as to keep their vital parts protected in a great measure. He notices the swift vessels recently supplied by Elswick to China as a formidable type of ship of only 1300 tons displacement, carrying two new type 10in. guns, capable of piercing 18in. of armour, as well as four 40-pounders, with sufficient coal for steaming 4000 miles, and withal able to attain a speed of sixteen knots when desired. The difficulty of protecting our commerce from such adversaries as these is apparent. For coast defence Sir William prefers earthworks to iron where they can be employed. He deprecates the crowding of guns together, and he thinks floating batteries generally preferable to forts standing like islands in the sea. Finally, the re-arming of our fleet he regards as a pressing need.

We think that most officers and engineers will concur in the above to a great extent. Nevertheless, we should qualify one or two of the conclusions arrived at. We cannot fully follow Sir William at present in his condemnation of armour. We admit much of what he says as to the advantage of swift, unarmoured ships, carrying new-type guns; but if we would make any real comparison it is necessary to define, as nearly as possible, the conditions under which the combat takes place. We will assume, then, that the three unarmoured ships are the class of cruiser above mentioned, and that the armoured ship is H.M.S. Iron Duke, the present flagship on the China station, carrying 8in. of armour on the water line, and 6in. on her battery, and armed with ten 12-ton guns. The basis of comparison is equality of price; we are therefore assuming that the three cruisers cost the same amount as the Iron Duke. We suppose that this is not very wide of the mark. We do not know whether a more heavily clad ship could be made for the same money now. The Iron Duke being some years older than the cruisers is undoubtedly at some disadvantage. This may be borne in mind, and for that reason we will not take into account the inferiority in range of her old type guns. Her speed is 12·8 knots. The cruisers' heavy 10in. guns would pierce the armour of the Iron Duke so easily that we may almost assume her to be pierced by each projectile that strikes her, even obliquely, and their high speed would give them a great advantage. They would, however, be compelled to use armour-piercing projectiles, which would only carry dead metal and langridge into the interior of the Iron Duke, to the same extent as may be witnessed at Shoeburyness when a shot pierces a target very easily. On the other hand, the Iron Duke might fire common and shrapnel shells. Sir William thinks that such shells would not open quickly enough to injure guns and men much. Yet in the Shannon trials a single shrapnel dismounted a gun and killed the whole of its dummy detachment. If the unarmoured ships were capable of catching fire, their danger would be increased.

In this, however, we are only differing in degree from Sir William's picture. Unquestionably small vessels, such as those supplied to China, would be very formidable at the longer ranges, where it would not be easy to strike them; and to our commerce they would be terrible. It would probably be difficult for ironclads, acting as a convoy, to protect merchantmen from them. A very plain conclusion to be drawn from this picture of armoured and unarmoured ships is the desirability of introducing medium new-type guns in the armament of our armoured ships. The spectacle of such a ship as the Inflexible endeavouring to meet the attack of a mosquito fleet, as it has been termed, with her four 80-ton guns moving in pairs, and her necessarily limited store of enormous shells would be a painful illustration of power awkwardly and wastefully employed.

Sir William, however, in speaking of coast defence and the use of torpedoes, has not, we think, sufficiently drawn the distinction between torpedoes proper, which are locomotive, and fixed submarine mines. At present harbours are mainly protected by the latter. Hence vessels in order to attack have to clear a limited area of water, and anchor so as to come into action against forts which can, in fact, be attacked only in this way. Here, we maintain, unarmoured ships would suffer cruelly, and in no way benefit by their speed. Open to the attack of smaller guns, which now exist in large number, and for long to come will crowd the batteries of harbours, they might be rapidly destroyed by a species of fire which such a ship as the Dreadnought might absolutely disregard. As long then as land batteries have to be engaged, armour will, we think, possess certain distinct advantages, especially in its complete form, although at anchor armour-clad vessels may be exposed to attack by high angle fire.

Whether we contemplate armoured or unarmoured ships, however, the question we have to face immediately is the rearming of our fleet. The introduction of long guns of the new type has given the power to an 18-ton gun to penetrate wrought iron armour which was formerly a match for a 38-ton gun. Broadside guns can, therefore, no longer be disregarded. Our policy has hitherto been to equip heavily clad vessels with a few very heavy guns; such vessels could defy lighter guns. In attack they delivered a few very heavy blows. We must now meet new type guns in broadside batteries and in mosquito vessels by guns of the same character, and we think the sooner this is commenced the better.

SMEATON'S EDDYSTONE LIGHTHOUSE.

IT has been seldom that objection has been made to the actions of the Trinity Board, but the demand of the Brethren with respect to the Eddystone Rock Lighthouse built by Smeaton will probably meet with very general censure. The new lighthouse is completed, and that of Smeaton, which has formed the model upon which all modern stone lighthouses have been built, is to be removed. Smeaton conferred a great boon on the whole nation, he built his world-famed tower, and as an engineer his ability has never been excelled. He was the great pioneer in the class of engineering to which England owes more of her present greatness than to any other profession, and the tower by which his name is most popularly identified would form a most fitting memorial of him and of an important period in England's engineering. The Mayor of Plymouth, in calling a meeting on Tuesday, "for the purpose of considering whether steps should be taken to communicate with the Trinity Board with a view to preserving Smeaton's Eddystone Lighthouse from destruction" only acted in accordance with what is without doubt the wish of English people. At the meeting it appears that the general view was that it should be carefully taken to pieces, that each block should be numbered, and the edifice re-erected on Plymouth Hoe in as nearly as possible its original condition, and take the place of the present unsightly obelisk. The negotiations with the Trinity House Brethren indicated, it was stated, that the town could only obtain the Smeaton Lighthouse by purchasing it as old material, and for delivering the stones at Plymouth in condition suitable for re-erection they would require to be paid £1800. The cost of re-erection would be £500. It was ascertained, however, that the Trinity Board did not propose to sell the whole lighthouse, the result of which would be that £4000 would be required to re-erect the building in its present form. The cost of numbering the stones cannot be a very considerable sum, and in any case the tower is to be taken down, and most if not all removed to shore. The Trinity Board cannot thus charge for this work; and supposing it cost £50 to mark the stones, it cannot but be looked upon as undignified on the part of the Board to want to make a profit of £1000 out of Plymouth. The Board ought to sacrifice a little to preserve this monument to Smeaton, and it is to be hoped that they will. The feeling of the meeting on Tuesday was that the preservation of Smeaton's Eddystone Lighthouse was a matter of national concern, and that in the circumstances, and having regard to the fact that Plymouth is engaged in raising a memorial to Drake, the Government should step in and relax the pecuniary requirements of the Trinity Board. It is, however, easy to talk of taking the tower down stone by stone, but bearing in mind how Smeaton built we do not see how this is going to be done.

THE PANAMA CANAL.

THE dispatch of Lord Granville chiefly in reply to those of Mr. Blaine, on the Panama Canal question, have been so well received in America that there will probably be no important difficulty in arriving at a settlement of the points concerned. The opinion of the Government is that the canal as the water-way between two great oceans and between all Europe and Eastern Asia is a work which concerns not only the American Continent but the whole world, and this view is that of the treaty of 1850. This view being apparently accepted by American people generally, it is not surprising that the *New York Herald*, which has devoted considerable space to the opinions of Congressmen on the question of the Panama Canal, comes to the conclusion that while the general belief among them is that if America wishes to control the canal she must make it, few of them care whether the canal be made or not. This undoubtedly, a *Daily News* correspondent says, is the attitude of the general public on the subject. People view the question with indifference. The agitation originates entirely with capitalists, who desire a subsidy to aid the construction of the canal. The same correspondent says that advices from Panama confirm the previous impression in America that M. de Lesseps' scheme is destined to fail, that much money has been invested, and very little work done. It does not follow that because much cannot at present be seen though much money has been spent, that little has been done, as the preliminary works often cost a very great deal and make little show; but it is remarkable at the same time that we get very little indication that much has really been done, though at the latter part of 1880 it was stated that the work was to commence at once, and a detachment of engineers and others did start early in 1881. No one can wish to throw cold water on such a scheme when the capital has been subscribed on the faith of its completion, but we should like to hear a little more of real progress with the canal, though it may be that work is not being pushed until the political aspect of affairs is settled. Lord Granville's despatch concludes by saying that the Government would gladly see the United States again take the initiative or issue an invitation to the Powers, and will be prepared to join in it or to support and endorse it in the way that may be found most fitting and convenient, provided that it does not conflict in any way with the Clayton-Bulwer Treaty. It is thus for the American Government to show that it is desirous that the canal shall be constructed and be free from individual control, but as these matters move slowly, progress with the work already commenced will be slow if M. de Lesseps is waiting for their settlement.

THE MIDLAND RAILWAY COMPANY AND MINERAL WAGONS.

TOWARDS the close of the present week most of the collieries on the Midland line, as well as owners of mineral and other wagons, have received an important circular, together with a form with regard to the purchase of private wagons, in accordance with a scheme which has been under the consideration of the directors for some time past. The proposal, which is looked upon with great interest, especially by those engaged in the vast mineral traffic, is doubtless one of the most important which has been made by the enterprising company. Should the offer be accepted, it would save a great amount of locomotive power, whilst it would to a great extent free the company's line of the traffic which is created by the return of empty wagons to the collieries and works—which forms a serious item of expense, as the company could deal with the wagons to much more advantage. When it is stated that during the years 1880 and 1881 the company forwarded to London alone 1,999,459 and 2,198,914 tons of coal respectively, some idea may be formed of the importance of the scheme. The following is a copy of the circular, which is dated:—"Midland Railway, General Manager's Office, Derby, February 13th, 1882.—You are doubtless aware that my directors have had under their consideration for some time past the purchase by mutual arrangement of the private owners' wagons running on the Midland Railway. Parliamentary powers to raise the first instalment of the sum needed for this purpose having been obtained, and the sanction of the shareholders to its creation given, I am instructed to ask whether you are willing to offer to the company those owned by you either in the form suggested in the accompanying document, or in some other way which you may consider preferable. It is proposed that the charge for wagon hire shall be in all cases kept separate from the rate, and that the charges authorised by the Midland Company's Act of 1881 shall be taken as a basis, subject to modification according to seasons and special circumstances. These charges are for distances not exceeding 50 miles, 6d. per ton; for distances exceeding 50 miles and not exceeding 150 miles, 1s. per ton; and for distances exceeding 150 miles, 1s. 3d. per ton. The object of my directors in purchasing the wagons is to keep in traffic, to the advantage of the traders and of the company, a regular and adequate supply of trustworthy wagons, suitable to the requirements of every description of traffic. I shall be obliged if you will favour me with a reply at your earliest convenience. Signed, JOHN NOBLE." The form which accompanies the circular provides that if the offer is accepted £10 per wagon shall be paid on delivery, and the balance by two equal instalments at the expiration of three and six months respectively from the determination of the price, with the addition to each instalment of interest thereon at the rate of 4 per cent. from date of delivery. The form provides a space for filling in the name of the valuer on behalf of the vendor, Mr. T. G. Clayton, of Derby, being named as the company's valuer; and in case they fail to agree an arbitrator to be appointed. The Midland Company agrees from and after the delivery of the wagons they will keep the vendor or vendors supplied with wagons according to the reasonable requirements of their traffic.

THE NORTH-EASTERN RAILWAY COMPANY.

THE half-yearly report presented to the shareholders of the North-Eastern Railway Company at its meeting lately held at York is decidedly interesting, and so were the observations made by Mr. Dent, the chairman, in explanation thereof. It appears that the recent lowering of fares, especially first and second-class, has not had the expected effect of increasing the proportion of travellers by those classes. The receipts from such passengers have considerably diminished, but the company has been more than compensated by increased receipts from third-class passengers. It is becoming more and more evident that second-class carriages are superfluous, and, bending to the popular will, the company is devoting great attention to making the third-class as comfortable as possible. Probably first and third-class carriages, with compartments in the latter reserved for ladies only, will be the fashion for the future. The directors intend to see if they cannot arrange that at their buffets a cup of tea or coffee shall be obtainable for something under 6d., which is a step in the right direction. The Saltburn and Whitby Railway, which was bought from a previous and liquidating company, at bargain price, is still likely to prove a dear purchase. The chairman doubts if it will ever pay. This is a lesson to engineers who lay out railways close to a coast line, where deep or broad estuaries have to be frequently crossed, and where landslips, as in the present case, often occur. Whoever endeavours to obtain or keep possession of territory which Neptune has marked out for his own, is apt to find he is contending with a power too strong for him. The lesson is to keep further inland. The dividend declared, viz., 8½ per cent., is not a bad one as things go.

TENDERS.

TENDERS for the extension of the sea wall and other works for the harbour of Carnarvon. Frederick Jackson, engineer. Quantities supplied.

	£	s.	d.
E. and R. Jones	8267	16	3
Whitaker Bros.	7991	10	0
J. and J. W. Roberts	6891	0	0
Owen Morris	6757	0	0
R. and T. Jones	6610	10	2
Evan Jones	6289	0	0
S. P. Owen	5697	12	0
David Williams	5453	14	8

NAVAL ENGINEER APPOINTMENTS.—The following appointments have been made at the Admiralty:—Sylvester Rawling, assistant engineer, to the Tenedos, *vice* Ball; William J. Sprake, engineer, additional to the Asia, *vice* Taylor; and Robert Phillips, engineer, to the Lord Warden, *vice* Fellows.

LITERATURE.

The British Navy; its Strength, Resources, and Administration By SIR THOMAS BRASSEY, K.C.B., M.P., M.A. Vol. I. Part I Shipbuilding for the Purposes of War. Longmans, Green, and Co., London. 1882.

THIS is a thick octavo of 605 pages, besides the index and fourteen folding plates. It may be regarded as a species of scrap-book, made up of cuttings from the *Times* and various other journals. These are dovetailed together with more or less success. Mr. King's work on European ships of war has been to all intents and purposes swallowed up bodily, engravings and all, and huge contributions have been levied from "Das Schwimmende Flotten-Material" of Captain von Kronenfels, "La Marine a l'Exposition de 1878," the *Army and Navy Gazette*, the *Broad Arrow*, and various other sources of information too numerous to mention here. It is not to be supposed that Sir Thomas Brassey has drawn on these authorities without saying so. On the contrary, he is scrupulously particular in acknowledging the sources of his information. This is no doubt gratifying to the authors quoted; but it is open to question whether it would not have been better to take the trouble to use his authorities as Macaulay, for example, used his when writing his history of England. Instead of reproducing what they have said word for word, it seems to us that our author would have done better to have re-written what they had to say. It is indisputable that for many years the reports in the *Times*, for example, on naval matters have been very good; although it will be in the recollection of many of our readers that the *Times* once said that the floats of the paddles of a certain war steamer were feruled at both ends, while the boilers were fitted with Morgan's patent feathering tubes. But good as the *Times* reports are, they are not quite what we expected to find in a work of great pretensions, prepared by so eminent an authority as a Lord of the Admiralty. We would not have it supposed that Sir Thomas Brassey has written nothing in this book. On the contrary, he has written a good deal, but it is not quite what we would have asked him to write, nor is it just what was wanted. Our meaning will be understood by-and-bye. Meanwhile, having indicated the nature of the book, we may proceed to set forth some of its author's reasons for, and purpose in, writing it. On these points he leaves no room for doubt, because, in the first place, he has given us an Introduction, and in the second place an Outline of the Plan of the Book. In his introduction Sir Thomas begins by writing in the third person, changing quickly into the first person, reminding us of the lady who writes, "Mrs. Jones presents her compliments to Mrs. Smith, and I will be obliged to you if you will give me a call at 4 p.m." "Some explanation," says Sir Thomas Brassey, "seems to be necessary of the unusual circumstance of the issue of a publication on naval affairs by a member of the Board of Admiralty. The present volumes were far advanced when the compiler had the honour of being invited to join that great department. He was equally reluctant to decline the invitation of the Prime Minister and to abandon the work in which so much progress had been made. On reflection, it appeared the wiser course to complete these volumes in the fitful intervals of leisure from official duty. It is unnecessary to dwell on the labour and perseverance bestowed on this self-imposed task, which is now approaching completion. I hail the prospect with a genuine sense of relief. As we reach the middle term of life and 'days decrease and autumn grows, autumn in everything.' It is natural to shrink from undertakings that can only be accomplished by continuous and protracted effort. Through twelve long years the work of this compilation has been going forward." Then Sir Thomas goes on to dilate on his parliamentary career, and says some things which, in deference to good taste, would have been better left unsaid. We do not dispute that the volume is dreary reading enough, and no doubt it has exercised a depressing effect on Sir Thomas. But it does not appear that he was compelled to compile this book, but rather that he took it up as a labour of love. This being the case, complaints—for they are nothing but complaints—such as we have quoted are unmeaning, to say the least of them. It is, however, fair to admit that Sir Thomas may have become more tired of his work before it was finished than he anticipated when he began it. It must be borne in mind that this is only one of six volumes, and the task of compiling is by no means so attractive as writing original matter. It will be seen that Sir Thomas Brassey practically admits that the book is a compilation, and this saves us from any charge of depreciating his performance unfairly.

We quite agree with Sir Thomas when he says, "Heavy indeed is the burthen of these six volumes, and narrow the circle of readers to whose libraries they will find admittance; but to all who devote themselves to the study of naval affairs, whether as administrators, as sea officers, or as owners of shipping, the present publication provides a collection of information such as it has not been attempted to bring together in any other work." It is quite true that there is no book—in English, at all events—which contains so much information of a kind; but it cannot fail to strike the reader from first to last that Sir Thomas Brassey has missed, and completely missed, the mark at which he has aimed. We have, for example, not a single complete description of a modern man-of-war. He persistently does not tell his readers just what they would like to know. This deficiency begins at the very beginning. The work, it will be understood, is historical to a very large extent. Thus, for example, the book proper commences with the introduction of shell guns, and then comes a reference to the Crimean batteries; then Sir Thomas goes on to speak of La Gloire, Invincible, Normandie, and other early French ironclads. The earliest ironclads—known as the Kinburn batteries—were invented by Napoleon III. These ships (!) went into action and fought the Kinburn forts successfully, "being," says Mr. Brassey, "entirely uninjured by Russian fire." Nothing whatever is said as to the character of that fire. It would have been quite possible to give all the information needed in ten or a dozen lines. This was the first real action ever fought by ironclads, and its results have revolutionised the art of constructing ships of war; yet Mr. Brassey simply says they went into action and came out again uninjured. Dozens of examples might be picked out to show that our author either does not know, or does not choose to supply, interesting information. In fact, we can hardly ever forget that we are dealing with a compilation, and that special information is not to be had; while information that might have been useful years ago, but which is now perfectly valueless, is supplied by almost every page. We may take, for instance, what Sir Thomas Brassey has to say about the Minotaur. She is practically obsolete. She is of enormous length, is fitted with five masts, is armoured with 5½in. plates, and carries 12-ton guns. This ship Mr. Brassey still thinks useful; well, so she is for certain purposes, but not for fighting. No less than four pages are devoted to the reproduction of *Times'* articles, written about this ship seven years ago, and some remarks by Captain, now Admiral, Scott, on the waste of money incurred in cutting new portholes in her sides. Again, we have a long reproduction from the *Times* concerning the Repulse, and we are supplied with such valuable scraps of information as the following:—"The Repulse was launched on April 25th, 1868, and having seen some ten years' service she has required an extensive overhaul." "The old crank-shaft, which was found to have been cracked, has been replaced by one which formerly did duty in the Donegal;" and so on. In fact, nine-tenths of that portion of the book dealing with the earlier ironclads might have been omitted, and replaced by some intelligent statement of what the qualities and performances of these ships were, and of the reason which led to their supercession. Turning over page after page of this portion of the work, we find quotation after quotation used without the least approach to intelligent criticism. Hardly any attempt has been made to condense information, and we are tempted to think that Sir Thomas Brassey had made a solemn vow that he would turn out six large volumes, and could not afford to be too nice in his selections.

It is not until Chapter X. has been reached that Sir Thomas Brassey begins to deal with modern types of ironclads. From thenceforth his book improves in character; but it is not because the author's duty is really better done, but simply that the matters on which he has worked are more interesting. We willingly admit that so much information of the kind concerning ironclads has never before been got within the covers of a single book; but it has all been published before, either in England, France, Germany, or Italy; and there is far too much useless matter given, while there is an entire absence of just that class of information which would be expected from Sir Thomas Brassey. We have only to open the book haphazard to find illustrations of our meaning. Sir Thomas is dealing with the Devastation. He quotes almost at full length a description of this ship given by Mr. Barnaby in a paper read before the Institution of Naval Architects in 1873. Now, no ship excited more attention than this vessel did, especially as regards her sea-going qualities. It is not too much to say that not a scrap of information concerning her performance at sea off the trial ground has been supplied to the public for years. We turn over the pages of Sir Thomas Brassey's book for any original statement on this subject and we do not find a scrap. Admiral Inglefield is quoted by Sir Thomas, "I have just returned from Malta, and saw the Devastation, having come into port from a long cruise. The captain spoke of the ship as being perfectly seaworthy, wholesome, and comfortable for the men and officers, and everything he could wish." We could wish that the men and officers—the engineer officers especially—of this ship could be heard on this point as well as the captain.

We hardly think it is necessary to extend our notice of Sir Thomas Brassey's book to much greater length, especially as we have something to say concerning the work of the engravers. By far the most valuable feature in the work is the illustrations. There are, as we have said, fourteen lithographed folding plates at the end. These give plans and elevations of nearly all the important ironclads in existence, showing in blue the armoured portions, while the position of guns and turrets is also clearly set forth. These plates are exceedingly instructive, and we are happy to see they are not confined to English practice alone, but illustrate many ships of foreign navies. There are besides 311 woodcuts, mostly of small size, and twenty-five full page illustrations. The small woodcuts are, on the whole, well done, and supply a great deal of information. Of the page illustrations it is impossible to say much that is favourable. The view of the Collingwood at sea, facing page 470, and that of the Italia with her six funnels, may be regarded as the best. The cut of the Sachsen is very bad. The drawings are in all cases spirited enough, but the engraving and printing, especially the printing, are bad. When will English publishers take a lesson from American publishers, and learn what a wood engraving ought to be? We can fancy what an American artist would have made of the engraving facing page 448 of the Duilio in action, and how it would have been printed in *The Century* or *Harper's Magazine*.

Finally, we may say that we shall look out with interest for the second volume of Sir Thomas Brassey's book. "The second volume," our author tells us, "contains papers on armour, armament, torpedoes, torpedo vessels, and other cognate subjects." As for the first volume, we need not advise our readers interested in ships of war to buy it. No question can turn up concerning the general features of any man-of-war that cannot be solved by reference to this book. An author may be proud of producing a volume of which so much may be said. It is, in short, a kind of "Inquire within on everything" connected with ironclad ships. The compilation of such works is not a great effort of genius; but books of the kind are useful, and whoever undertakes to write what has never been written yet, namely, a good treatise on ships of war, will find that Sir Thomas Brassey has provided them with a good deal of matter ready for assimilation.

ELECTRIC CHANDELIER.

MADE BY MESSRS. VERITY AND SONS, KING STREET, COVENT GARDEN.

CRYSTAL PALACE ELECTRICAL EXHIBITION.

No. I.

Three years ago—that is in February, 1879—Mr. Mattieu Williams, a well-known and able scientific writer, in an article in the *Journal of Science*, on Starr-King's incandescent electric lamp, patented in 1845, says: "During the intervening thirty years I have abstained from further meddling with the electric light, because all that I had seen then, and have heard of since, has convinced me that —although as a scientific achievement the electric light is a splendid success—its practical application to all purposes where cost is a matter of serious consideration is a complete and hopeless failure, and must of necessity continue to be so." The *raison d'être* of the Crystal Palace Exhibition is to show that the electric light is not a failure, and that it daily promises to be as economical as the gas at present supplied. Supplementary to the light exhibits at the Palace are the numerous exhibits showing the immense developments of the applications of electricity during the past few years.

A visit to the Palace can now be made with every prospect of seeing the principal electric lights in operation. They will not, however, be all ready for another week or two. The visitor should commence systematically, comparing when possible arc lights with arc lights, incandescent with incandescent, and so on. He must not think of getting a full and complete knowledge of details. Externals alone are within his view. The cost must be taken as stated by the exhibitors, or as published by the technical press. Starting then at the north end, the tropical courts are illuminated by the Lane-Fox incandescent lamp, and the Brush arc lamp. Coming southwards we notice the beautiful Weston arc lamps of the Electric Light and Power Generator Company, which also shows congeries of Maxim incandescent lamps. Then follows the British Electric Light Company, with the Brockie lamp; while the central transept and stage are lighted by the Crompton lights, and the orchestra with the Pilsen lamp. Above the crystal fountain hangs a fine chandelier, carrying Siemens lamps. Before coming to these, however, we notice the Mackenzie lamp. The André, Jablochkoff, and other lamps will be seen in due course.

The centres of attraction outside of the transepts will be the Picture Gallery, illuminated by Swan lamps, and the Concert and Entertainment Courts, illuminated by Edison lamps. We shall deal hereafter with the systems above-mentioned, as well as others which may have escaped this rapid review. Meanwhile we may call special attention to an accessory of the electric light, as it will show that, should Mr. Mattieu Williams be mistaken as to its future, the industrial branches dependent on gas may expect further developments, requiring a variety of designs and good workmanship. We refer to a chandelier especially designed and made by Messrs. Verity and Sons, of King-street, Covent Garden, for Mr. E. H. Johnson, of the Edison Light Company. This is placed in the Entertainment Court. It represents a huge basket of flowers and is made wholly of hammered brass. Its height is 15ft., whilst it measures 9ft. across. The flowers represented—of which there are about 350—are the large sunflower, the narcissus, the tiger lily, the orchid, &c, down to the small clove pink. Edison lamps are placed within the cups of the flowers. There are ninety-nine such lamps in three circuits, and when lighted, the light of the lamps and the blending colours of the glass cups are effective. The brass representing the stems of the flowers is of course hollow, and the thousands of pieces are so arranged that comparatively little difficulty was encountered in wiring the lamps. Our illustration has been engraved from a free-hand drawing specially taken for us. The lamps in each circuit can be turned on or off as required.

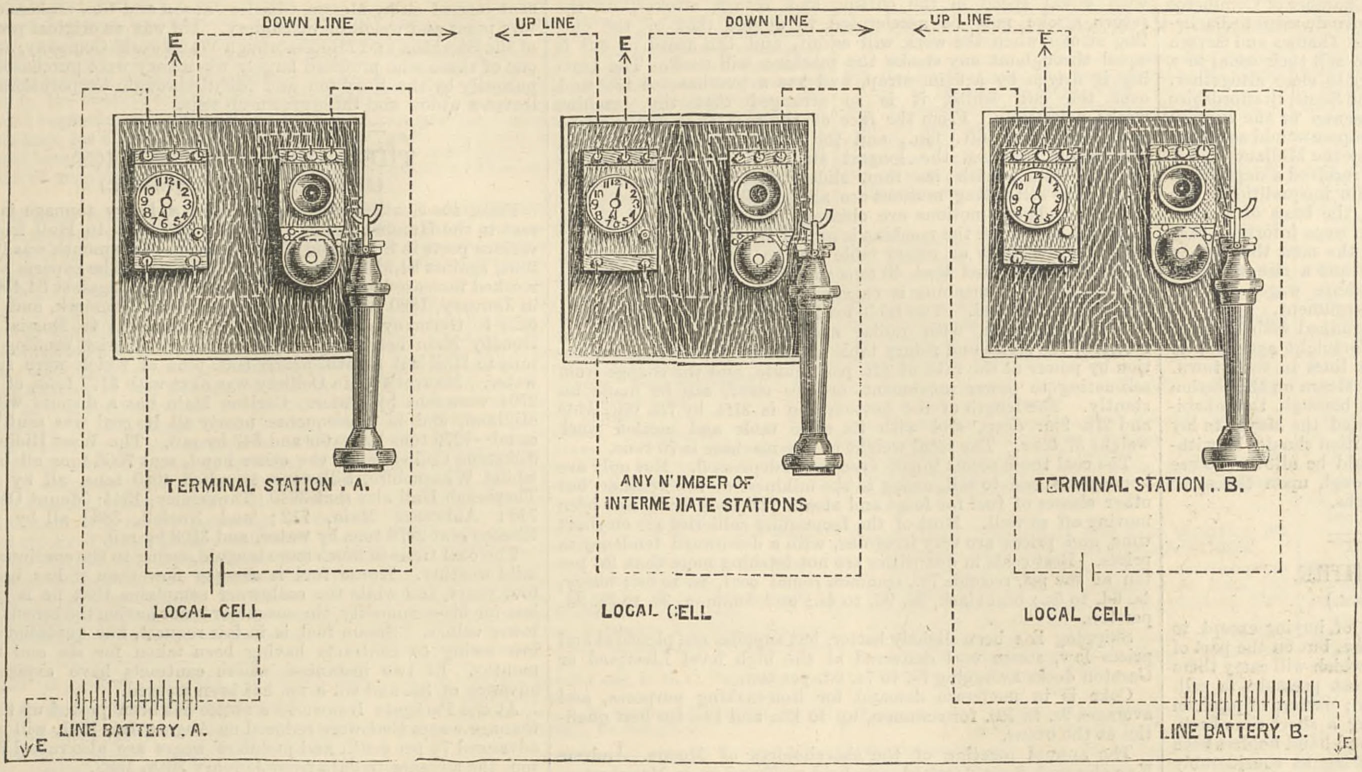
If it be possible to interest the visitor to the Palace in aught except the lights, he will do well to study the improvements that are taking place in telephones. At a recent exhibition at the Bristol Hotel by the United Telephone Company, it was shown that a number of people could receive the same sounds on different instruments, and still more recently at the houses of Colonel Gourand and Major Flood Page it has been shown that conversation can be carried on over the line whilst at the same time the musical sounds of an organ or orchestra are being carried. This points to the fact that the telephone will take up a number of sounds at one and the same time. Under ordinary business conditions, however, this sensitiveness is troublesome, and hitherto each user of a telephone has been compelled to have a distinct wire for his work. The introduction of exchanges minimised the length of wire used, but we think the instrument of Messrs. Brown and Saunders, shown by the Eastern Telegraph Company, 66, Old Broad-street, is certainly a decided advance in telephonic work. By its use one line can be used by a number of instruments, and this, too, without danger of anyone but the right person overhearing the conversation; in other words secrecy is maintained. The instruments used are designed for twelve to be placed on the one line. It is suggested that the apparatus would be very useful in suburban districts, or wherever the work of the line was light, as well as in large factories; but we fancy its utility will extend further than this, and that it will be found that no evil effects will arise from putting three or four instruments on most of the wires belonging to the larger exchanges. If this surmise is correct then we have at once the means of diminishing considerably the dangers arising from the multiplication of so many wires. The apparatus is compact, and consists of a transmitter and receiver, with a bell and local battery. At the terminal stations the line batteries are placed to work in opposition, so that, except in the act of signalling, no work is required of them; hence they remain active for a long time. The signal instrument consists of a clockwork movement A—Figs. 1 and 2—controlled by an electro-magnet D, and actuating a main arbor or axle C. This axle carries a hand B to indicate the numbers of the respective subscribers; also a slotted disc H and a cam I. Metallically attached to the main framework is a ringing spring K, which extends over the slotted disc H, and under normal conditions makes contact with the spring L, which is attached to the main framework by a piece of ebonite. Affixed also to the main framework by the same piece of ebonite is another spring P, which rests on the top of spring K, but is insulated from it by an ivory stud. This spring P when spring K is pressed falls upon and makes contact with a screw stud *p*, screwed through the top of the main framework, but otherwise held out of contact therewith by spring K. When the hand B comes round to the number or signal belonging to the station in which that particular instrument is placed, the cam I comes into contact with and slightly lifts the ends of two springs N and O, attached by a piece of ebonite to the main framework, as shown, and in so doing breaks the contact of N with a screw stud with which it normally makes contact when not so lifted by the cam. Two terminal and an intermediate stations are shown. The index shows the number of subscribers to stations on the circuit, and the position of the pointer indicates the station called. The call is made by a push like an electric bell push. The push causes the pointer to go forward one half step; the release causes it to go forward another half step; and this action is continued till the number of the station required is reached, when attention is roused by the ringing of the bell. The action of the instruments will be understood if we state how the connections are made. At a central station the positive pole of the local battery is connected to terminal L C, Fig. 1; the negative pole to L Z, Fig. 3; the terminal E is put to earth. One line—say, the up line—is connected to L^1, and the down line to L^2 S^2. The terminals S^1 T C are connected as shown. At the terminal stations what we have called the up wire is connected to the zinc pole of the line battery, the copper pole being put to earth. The details, although they may seem complicated, are not so, but will be readily understood.

The connections are then as follows:—A wire leads from the line 1, marked L_1, or upper left-hand terminal of the signal, looking at it from the front, to the electro-magnet D, the other side of this coil being attached to the main framework. The current then goes by the terminal marked S_1 and T C, being the lower right-hand terminal, and the similarly lettered or centre terminal on the switch bell transmitter, Fig. 3, to one side of the secondary coil of the induction coil, calling on its way at the top—or centre of motion—of the switch hook as shown. From thence the current goes on through the secondary and telephone or telephones to the under stud of the switch-hook, or to that stud with which the hook makes contact when the telephone is hanging thereon, and thence on to the terminal marked S^2, being the left-hand terminal of the switch bell transmitter, and thence on by the short external bridge wire between the two instruments to line.

There is thus always a complete circuit through the instrument for the current by the parts above named. The part of this circuit consisting of the telephone and secondary, however, is normally kept short circuited by two distinct methods, as follows:—One of these shunt circuits starts from the clock frame by the spring K, which is normally in contact with spring L, and thence goes on to spring N, which is normally in contact with its screw stud; from which a wire leads to the terminal marked line 2 or L^2, being the upper right-hand terminal of the signal, which is also the terminal to which the wire from the other end of the secondary and telephone is joined. The other short circuit is through the switch hook, as will be seen when the telephone is hanging thereon, but this short circuit is, of course, broken when the telephone is taken off the hook. This completes the set of connections for the line circuit.

For the local circuit a wire is then run from the copper pole of the local cell or cells to the terminal L C, being the lower left-hand terminal of the signal. From here a wire leads on to the lower cross spring P, and also to the lower spring O of the pair of springs N O. It will be seen that at both of these points local copper is capable of being put into contact with the main framework, either by hand —by pressing spring K, and so dropping spring P on to

MESSRS. BROWN AND SAUNDERS' TELEPHONE SYSTEM.



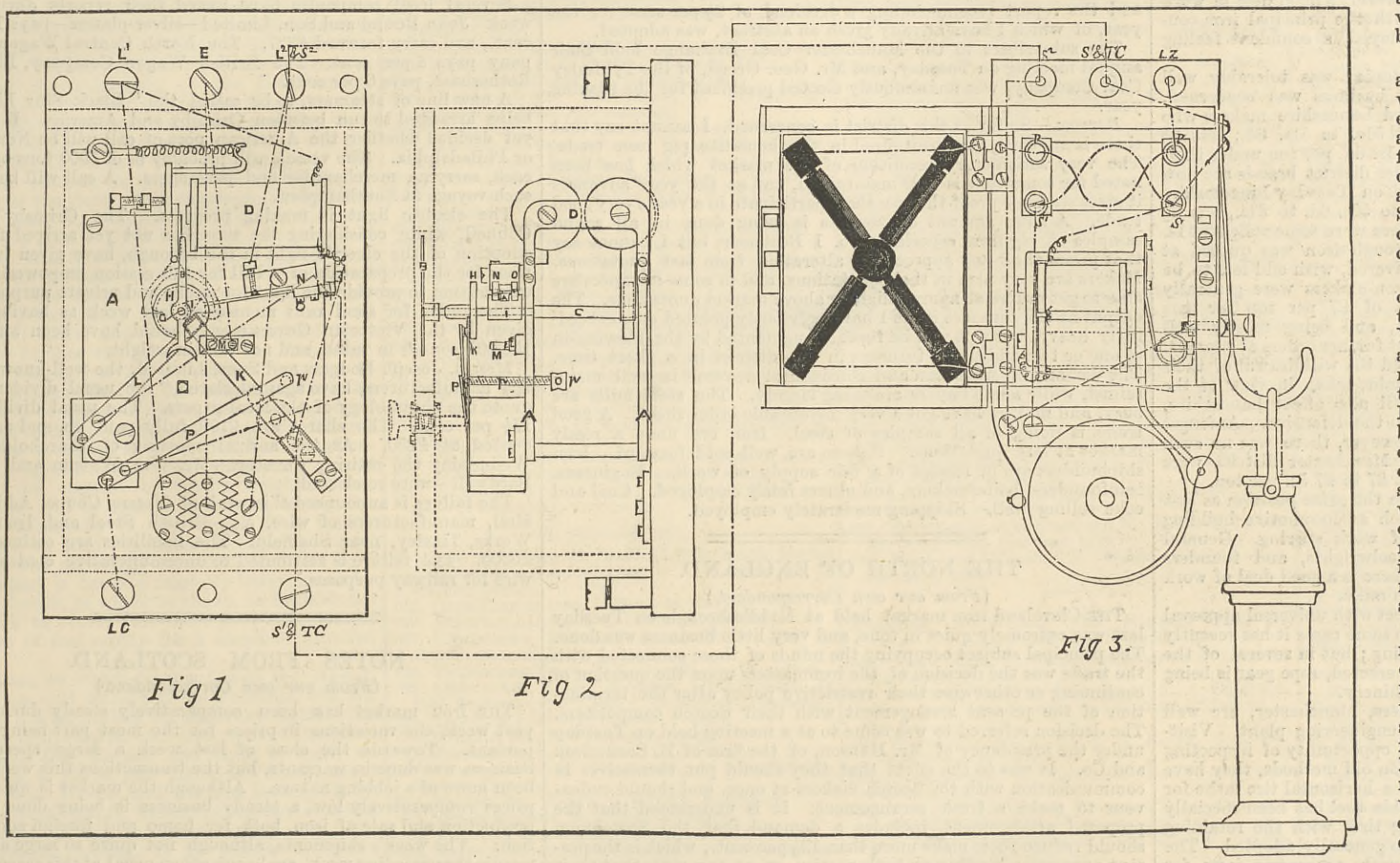


Fig 1 Fig 2 Fig 3.

its contact stud p in the frame—or automatically by bringing cam 1 into contact with spring O.

The action of the apparatus is as follows:—The hands standing at zero—indicating that the line is disengaged—any subscriber can call by pressing his ringing plunger. The spring K will then be pressed through the slot in the disc on to a stud M, which is in electrical connection with the earth terminal E, or upper central terminal of the signal—the slot in the disc H being then, and then only, in position to allow of this taking place. This puts an intermediate earth on the line, and so brings the opposed line batteries into effective action; the one battery working all the instruments on the one side of the caller, including his own instrument, and the other battery working all the instruments on the other side of the caller, the effect of the current being to draw up the armatures of all the electro-magnets D, and so cause the clocks to advance one half step. By then letting the plunger come back, and so breaking the contact of spring K with the earth stud M, the armatures will be again let go, and the clocks will advance another half step. By then alternately pressing and releasing the plunger, the subscriber can bring the hands round to the number he wants, and there stop. The cam I in the instrument belonging to that number will then be in contact with spring O, thus ringing his bell, and will also, by breaking the contact of spring N with its contact stud, break the short circuit through the signal of the telephone and secondary, thus placing him in effective speaking condition. It is then his duty to answer by taking off his telephone and calling "Yes" through the transmitter, the act of taking off his telephone automatically removing the remaining short circuit thereof and at the same time short-circuiting the bell, thereby stopping its sounding and concentrating the local current on to the transmitter.

The local current having been put on to the main frame-work will traverse the following circuit:—First it passes out of the signal instrument by the terminal S' and T C, and the outside connecting wire to the similarly lettered terminal on the switch bell transmitter along with the line current, with which, however, it makes no contact, in consequence of there being no connection whatever with the other pole of the local battery except by its own wire. From the top or centre of motion of the switch hook, then, to which this terminal is connected, the local current goes on through the bell coils to the upper stud of the switch hook—or that stud with which the hook is in contact when the telephone is removed therefrom—so that when this is the case the bell is short-circuited. From this point the current goes by the transmitter and primary coil of the induction coil to the terminal L Z, being the right-hand terminal of the switch bell transmitter, from which a lead is run back to the zinc pole of the local bell or bells, thus completing the local circuit.

THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND OTHER DISTRICTS.

(*From our own Correspondent.*)

THE employers upon the Iron Trade Wages Board of this district have had to follow the lead of the similar board in the North of England, and advance the wages of the ironworkers. The board met on Monday in Wolverhampton, employers and operatives being fully represented. The threats of the operatives, to which I last week adverted, had led to the meeting, which was made the annual meeting, though the date for that gathering had not come round. It was impossible for the operatives' section to justify the demand for higher wages, since the rules of the board determine wages by prices, as ascertained by the accountants upon examination of specified employers' books quarter by quarter. Nor did they, indeed, attempt to justify it. They put the mildest possible face upon it, and inquired whether, as a matter of expediency, to keep the men from removing to the higher paid district it would not be better for the employers here to concede an advance. Informally, however, intimation had been conveyed to the employers' secretary of the nature of that with which my readers are already familiar. After retiring for half an hour the employers returned with the following resolution, to which they had all agreed: "That the request of the operatives for an advance of 9d. per ton for puddling, and 7½d. per cwt. for millmen, be acceded to, and commence this day, and be continued until the 30th of April next, and thenceforward in the absence of notice to the contrary given by either side. This necessarily puts an end to the sliding scale." As these were their own terms, the operatives could not but accept them. They have obtained an immediate rise, which puts up the remuneration for puddling from 7s. 3d. to 8s. per ton, and that for other work in the same proportion; but they have sacrificed the sliding scale, and Mr. Fisher-Smith, the representative of the Earl of Dudley, took occasion to state that he would "never be a party to another sliding scale." Yet an effort will probably be made to come to some arrangement at the end of April whereby wages shall still be the subject of representative negotiation. Meanwhile the average prices will not be taken out by the board's accountant, and the men will not know upon what terms they would have been paid in the three months succeeding the publication of the prices ascertained up to the close of April. That there would have been a rise at that time there is no room for dispute.

Upon the finished iron trade throughout much of the kingdom the result of the meeting will be sensibly felt. The Wages Board in Wolverhampton regulates wages not merely in Staffordshire—north and south—and in Worcestershire and Shropshire, but also in Lancashire, Derbyshire, and South Yorkshire. Throughout all those districts, therefore, it may be assumed that it has cost more by over 3s. 6d. per ton on an average to make finished iron this week than it cost a week ago. Boiler plates cannot be made in South Staffordshire at less than a rise of quite 4s., nor sheets of the lattens gauge at less than a rise of 6s., and there are firms who for no more service will this week have to pay from, say, £25 to £75 and £100 more than they paid last week, and yet will be unable probably to recoup themselves in more than a minor degree for some weeks to come. They will certainly be unable to do so in respect of any of the orders which they may have taken up to the time when it was assumed that in the ordinary working of the wages scale wages would have to be paid upon the basis of 7s. 3d. per ton to puddlers.

To-day—Thursday—in Birmingham, and yesterday in Wolverhampton, there was great complaining amongst the employers at this flagrant breach of agreement by the operatives. Certain firms declared that they could not take orders on the basis of their current lists, and at least one firm—that of Messrs. E. S. Wright and Son—have issued a circular withdrawing the lists now in circulation.

Few medium iron makers would accept orders at less than a rise of from 2s. 6d. to 5s. upon their last week's terms. Yet where specifications are needed on account of orders before in hand, sheet makers were prepared to divide with their customers the higher cost of labour. In such cases, therefore, prices must be quoted down upon the week half-a-crown per ton. And there was more complaining this week than last that specifications are not coming forward with the freedom promised when the orders were booked. The prospects are nevertheless declared to be good; and in the augmentation of puddling furnace facilities, leading firms are steadily and persistently occupied.

The local brands of pig iron mostly in request are not being produced in excess of consumption, and firms who in their forges and mills use up the outturn of their own blast furnaces, are, with several of the firms who smelt pig iron for sale, preparing to increase their make. By the setting on of a third blast furnace the New British Iron Company will be finding for its forge and mill department some ninety tons of crude iron every twenty-four hours.

To-day and yesterday pig makers' quotations were mostly a shade stronger, because of the rise in the wages of the finished iron hands—a rise which is likely to be reflected in certain action by the blast furnace hands.

Quite a gloom was cast over the market in Wolverhampton by the news that only two or three hours before 'Change opened there Mr. John Addenbrooke had been cut down by a passing express train, not far from his colliery, at Lea Brook, near Wednesbury. Mr. Addenbrooke was greatly and deservedly esteemed by his fellow iron and coal masters, and he leaves a numerous family, some of whom are yet young. Mr. Addenbrooke was a member of the Mines Drainage Commission, on which body his brother George, of Leamington, still holds a similar position.

The whole of the puddling and the reheating furnaces at Earl Dudley's Round Oak Works are now fitted with the Casson-Bichereoux system of gas heating. A large furnace has just been laid down there capable of heating piles of two tons weight. In addition to its effecting a great saving in fuel, this system leads to the consumption of much smoke; and there is expectation of its being adopted in the neighbourhood of manufacturing towns because of its smoke-consuming capabilities.

Merchant advices delivered this week from Melbourne state that when the mail left galvanised iron was in considerable request, and sales were making at £21 10s. to £22 10s. and £23 for 26 gauge, according to brand. A shipment of 50 cases "Gospel Oak" had been taken up a week before the mail left, and 100 cases had been up the same week at a full price; 50 cases Davis's brand had been placed at £21 15s., and 25 cases of another brand were quitted at £21 10s. Bar and rod iron were in request at £9 10s. to £11. Black sheet iron was selling steadily. Assortments of Nos. 8 to 18 were being quitted at £11 10s., while for Nos. 20 to 26, £13 10s. to £14 was obtained. Plate iron was very saleable, merchants quoting £11 to £12. Hoop iron for trade purposes was offered at £9 10s. to £10. Nos. 6, 7, 8, drawn fencing wires were in good request, sales being made at £13 5s., £14, and £14 5s. respectively.

Tin-plates placed in Melbourne were offered, it is learned, at 15 per cent. advance on invoice for good assortments. I. C. coke was saleable at 20s. on spot, and at date of advice a shipment of 500 had been made. In the same market when the mail was dispatched pig iron was moving for ordinary requirements at £5 5s. to £5 10s.; for anything like parcels, however, £5 was accepted.

The Old Hill district miners have passed a resolution pledging them to agitate for improvements in the Mines' Regulation Act, and also for the appointment of practical miners as colliery inspectors. A further resolution in favour of joining the Staffordshire and East Worcestershire Permanent Provident Society has been also passed.

A good business year in the railway fastenings industry has not been without its beneficial effects on local manufacturers. The Patent Nut and Bolt Company, Limited, has done a good trade in rail fastenings, and has made a net profit on the year of £37,784. The company is about to pay a dividend of 10 per cent., to place £10,000 to the reserve fund, and to carry forward a balance of £4967.

At their last meeting the Wolverhampton Chamber of Commerce drew up a protest against Bills shortly to be introduced into Parliament by the Regent's Canal Company and the Thames and Severn Canal Company. The first seek for powers to sell their canal to a railway company, and the second for powers to close altogether. The protest will be entered on behalf of the South Staffordshire trades, as these canals form part of the waterway to the western coast, and any such alteration as the Bills propose would seriously affect the large traffic now kept up on them by the Midlands.

The masters of North Staffordshire have received a deputation of coal and ironstone miners, who made certain inequalities in the wages of the ironstone getters in particular, the basis of a claim for an advance of wages all round. The men were informed that while the masters were equally anxious with the men that selling prices should attain a point that would warrant a rise in wages, they found it impossible to at present advance wages, for the nequalities enumerated formed no sufficient argument.

The people of Longton seem equally determined with those of Burslem—as to which I said something a fortnight ago—not to be deprived of the use of steam on the tram lines in their town. The Town Council having vetoed the use of steam on the section of tramways running along the streets of the borough, the inhabitants, at a public meeting, have just requested the Mayor to lay before the council a petition that this opposition should be withdrawn, and that the tramway company should be allowed to use steam engines upon all lines within the borough upon the same terms as those in force in neighbouring boroughs.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There is a continued absence of buying except to the most limited extent in the iron market here, but on the part of makers, who have still deliveries to complete which will carry them well over the present quarter, there is no great pressure to sell. The market is, however, unquestionably easier; makers of pig iron are prepared to take less than they were asking a short time back, and a decided weakness is being shown by second-hand holders both of pig and manufactured iron, who are offering at considerably under makers' quotations. There is, however, a good deal of work in hand throughout the district, and with the principal iron-consuming branches of industry well employed, a confident feeling with regard to the future is maintained.

The Manchester iron market on Tuesday was tolerably well attended, but extremely flat so far as business was concerned. Pig iron met with very little inquiry, and Lancashire makers who were sellers up to the end of June at 51s. to 51s. 6d., less $2\frac{1}{2}$ delivered equal to Manchester, or 1s. to 1s. 6d. per ton under their list rates, were not booking orders. Other district brands are now coming in at under the local irons, and on Tuesday Lincolnshire makers brought down their quotations to 50s. 6d. to 51s., less $2\frac{1}{2}$ delivered equal to Manchester, whilst there were some sellers at 1s. to 2s. under these figures. Middlesbrough iron was quoted at about 50s. 4d. to 50s. 10d. net cash, delivered, with odd lots to be bought for a little under. Finished iron-makers were generally tolerably firm at their late quotations of £7 per ton for bars delivered into the Manchester district, and being mostly well supplied with work were indifferent about further orders at present. Agents of Staffordshire houses announced the withdrawal of their quotations, and as this step was, no doubt, taken in view of the upward movement in wages, which will also affect Lancashire, local makers will in all probability act on the defensive. Amongst second-hand holders of finished iron, however, there was no such firmness, and bars delivered into the Manchester district were offering at £6 15s., with hoops quoted at £7 to £7 5s. per ton.

The engineering trades remain in much the same position as last reported. In the heavier branches, such as locomotive building and boiler making, there is plenty of work stirring. General engineers, tool makers, machinists, wheelwrights, and founders are also, as a rule, well employed, and there is a good deal of work giving out in connection with new cotton mills.

Rope driving gear, I know, does not meet with universal approval in the cotton mills of this district, and in some cases it has recently been taken out to be replaced by shafting; but in several of the large new works which are now being erected, rope gear is being specially introduced for driving the machinery.

The works of Messrs. Craven Brothers, Manchester, are well known for specialities in tools and other engineering plant. Visiting these works the other day I had an opportunity of inspecting several new machines, or improvements on old methods, they have at present in hand. Amongst these was a horizontal tire lathe for turning tires up to 7ft. in diameter. This tool has been specially designed for reducing the cost of turning tires with the retaining rings made to slide with the tires, now so generally adopted. The machine has a horizontal face-plate, with concentric jaws for holding the tire, and there are three tool holder slides placed in tripod form at equal distances in the circle, the slides being so arranged that the tools are always pressing them to the surface, and not being drawn away, as is not unusually the case with duplex tools of this class. The tool slides are all separately self-acting on the vertical and horizontal movements, and the face-plate is driven by powerful gearing with ten changes of speed. Another speciality was a tool for drilling and tapping the screw holes in roof bar stays for locomotive fire-boxes. This machine has seven vertical spindles for drilling an equal number of holes at the same time. When these are drilled the table carrying the stay is lowered from the drills, which are then removed from the spindles, and seven taps being put in their place the holes are tapped, after which the taps are withdrawn. The stay is then moved endways and seven intermediate holes are tapped and drilled as before, thus completing the fourteen holes which have to be drilled and tapped in the stays. In working the machine the spindles have a slow forward rotary motion for tapping the holes, with a quick return motion for withdrawing the taps from the holes. The machine is self-acting for drilling, with balanced spindles, for tapping, and also for raising and lowering the stay to and from the bath of lubricant, in which it is immersed while being drilled and tapped, and these movements being all effected by power, there is a great saving of labour to the attendant. I also saw in hand a number of specially designed duplex drilling machines for drilling fish-plate bolt holes in the ends and flanges of railway rails, either in round or elongated form, whilst the adjustment of the drills, to get accuracy of pitch, &c., can be readily made without stopping the machines or disarrangement of the gearing driving the spindles.

Another important section of work carried on by the firm is the manufacture of an improved travelling rope-driving crane having three separate motions. This crane is the outcome of improvements which Messrs. Craven originally carried out to facilitate the work of their own establishment, but it has since been received with so much favour by the trade generally that an extension of the works has been necessary to carry on this branch of engineering. For this purpose an entirely new shop has recently been erected, fitted with special tools, and the first crane made in the new shop is now being completed. The crane is so constructed that every motion is under easy control, whilst the operator has a clear view of the shop floor and can be readily communicated with; whilst travelling along the shop floor the crane can also be set in motion backwards or forwards to either side and simultaneously raise or lower any load which is being dealt with. These cranes, which have been supplied to the new works of Sir Joseph Whitworth and Co., have been constructed to lift up to 80 tons, and one which I saw almost ready for starting out had a span of 53ft.

Messrs. Craven Bros. have also recently completed an exceptionally powerful slotting machine, specially designed for marine engine work, which is probably the largest machine of the kind yet constructed. In this machine the maximum stroke of the ram is 10ft., and the minimum stroke 9in. It can be worked with equal speed in the cutting and return strokes, or the return stroke may be accelerated to double that of the cutting stroke when the work will admit, and the speed of cut is equal throughout any stroke the machine will work. The gearing is driven by a $6\frac{1}{2}$in. strap, and has a purchase of 130 to 1 over the cut, whilst it is so arranged that the machine works noiselessly. From the face of the tool slide to the frame the distance is 6ft. 6in., and the total height from ground line when working the longest stroke is 30ft. The weight of the frame, with its ram, slides, and driving gear is 30 tons. The self-acting motions are all variable from 4 to 64 cuts per inch. These motions are obtained from the gearing of the machine, and when the machine is out of its work or at the top of its stroke the slides or rotary table can be moved in either direction. It is estimated that 40 tons will have to be moved by the gearing when the machine is engaged upon the heaviest work for which it is intended. The table for holding the work is 10ft. long by 7ft. 6in. wide, with radial ends. Besides the self-acting motions, the slides and rotary table can be moved in either direction by power at the rate of 8ft. per minute, and the change from self-acting to power movement, or *vice versâ*, can be made instantly. The length of the bottom bed is 21ft. by 7ft. 6in. wide and 2ft. 9in. deep, and with its slide table and motion work weighs 37 tons. The total weight of the machine is 70 tons.

The coal trade seems to get even more depressed. Not only are house coals bad to sell, owing to the mildness of the weather, but other classes of fuel for forge and steam purposes have not been moving off so well. Most of the Lancashire collieries are on short time, and prices are very irregular, with a downward tendency in prices. Best coals in quantities are not fetching more than 9s. per ton at the pit, seconds 7s., common round coal, 5s. to 6s.; burgy, 4s. 6d. to 5s.; best slack, 3s. 9d. to 4s.; and common, 3s. to 3s. 3d. per ton.

Shipping has been slightly better, but supplies are plentiful and prices low, steam coal delivered at the high level Liverpool or Garston docks averaging 7s. to 7s. 6d. per ton.

Coke is in moderate demand for iron-making purposes, and averages 9s. to 10s. for common, up to 12s. and 14s. for best qualities at the ovens.

The annual meeting of the shareholders of Messrs. Andrew Knowles and Sons, Limited, was held on Tuesday, in Manchester, and the report recommending a dividend of $2\frac{1}{2}$ per cent. for the year, of which I have already given an abstract, was adopted.

The subscribers to the Manchester Coal Exchange held their annual meeting on Tuesday, and Mr. Geo. Green, of the Tyldesley Coal Company, was unanimously elected president for the ensuing year.

Barrow.—So far as this district is concerned, I cannot say that there is anything new transpired in the hematite pig iron trade. The very satisfactory condition of the market which has been noted for some time is well maintained, and as the year advances it gives stronger proof that we shall participate in a year's very good trade. A large amount of business is being done in all round samples of pig iron, especially No. 1 Bessemer, but I cannot say that prices show any appreciable alteration from last quotations. Makers are very firm in their quotations, and in some instances are able to get orders at figures slightly above market quotations. The output at the furnaces is, as I have previously pointed out, exceedingly heavy, but this will be further augmented by the blowing-in of one or two additional furnaces in the district in a short time. The demand on American and continental account is well maintained, while home buyers are using largely. The steel mills are busy, and makers have got a very favourable order sheet. A good trade is doing in all samples of steel. Iron ore finds a ready market at last quotations. Raisers are well sold forward. Iron shipbuilders are in receipt of a fair supply of work. Engineers, ironfounders, boilermakers, and others fairly employed. Coal and coke selling well. Shipping moderately employed.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland iron market held at Middlesbrough on Tuesday last was extremely quiet in tone, and very little business was done. The principal subject occupying the minds of those connected with the trade was the decision of the ironmasters upon the question of continuing or otherwise their restrictive policy after the termination of the present arrangement with their Scotch competitors. The decision referred to was come to at a meeting held on Tuesday under the presidency of Mr. Hanson, of the firm of B. Samuelson and Co. It was to the effect that they should put themselves in communication with the Scotch makers at once, and should endeavour to make a fresh arrangement. It is understood that the proposed arrangement includes a demand that the Scotchmen should reduce their make more than $12\frac{1}{2}$ per cent., which is the present proportion binding on both parties, or, at any rate, that their restriction shall be more than that to be applied to Cleveland. The Cleveland ironmasters think they have strong arguments in favour of the justice of this demand. They point out that since September last their stocks have been diminished by fifty to sixty thousand tons, whilst stocks in Scotland have increased to about the same extent. If the restrictive arrangement had not been in force at all it is probable that Cleveland would still not have suffered, whilst in Scotland some of the makers would have been forced into liquidation.

The general effect on the market of the element of uncertainty as to the future thus introduced was to curtail business. Smelters would not quote at all, unless at figures which were virtually prohibitive. Merchants did not care to commit themselves, except for small lots for prompt delivery. Consumers seemed quite content to wait. Iron manufacturers have scarcely yet got over the depressing effect of the recent concessions wrung from them by labour. Their profit on existing contracts has largely disappeared in this way, and should they have to pay more for pig iron they may in several cases find themselves working at a loss. With such feelings fresh upon them they were not keen buyers and would not hear of higher prices.

No. 3 g.m.b. commanded 41s. 9d. for prompt f.o.b. delivery, and 42s. for delivery over the second quarter; No. 4 forge iron was 1s. per ton less. Connal's warrants were 42s. per ton. These prices are less by about 6d. per ton than those of the previous week. The stock in Connal's Middlesbrough stores is now 172,531 tons, being an increase of 1886 tons over the last return. Manufactured iron was quiet but steady. Several thousand tons production have been entirely lost by the general strike which took place early in the month. This, together with the increased cost of production ensuing, would have probably led to a rise in values but for the tendency manifested by pig iron to fall. The result has been a maintenance of the *status quo*, viz., ship-plates, £7 5s., and bars and angles £6 12s. 6d. per ton on trucks Middlesbrough, less $2\frac{1}{2}$ per cent. discount.

The Walker Rolling Mills Company has made a beginning by setting to work twelve puddling furnaces, after remaining idle for five years. It is hoped that their total number, which is thirty-six, will soon be in operation, as well as their plate mill.

The North Yorkshire Works, at South Stockton, will also soon make a beginning in the manufacture of puddle bar. It has been definitely decided to devote these works to the manufacture of angles and bars, and not plates as was originally intended. The great need of the northern finished iron trade is more ironworkers, and especially heaters and puddlers. Now that wages have risen there should be no lack of inducement for an immigration from less active districts.

The death is announced at Redcar, in his 74th year, of Mr. Alfred Kitching, J.P., of Darlington, a director of the North-Eastern Railway. Mr. Kitching was formerly an ironfounder and engineer, having established a business at Hopetown, near Darlington, as far back as 1832, and built some of the earlier locomotives. He removed from thence in 1862 to the Whessoe Foundry, at present carried on by Messrs. Charles Janson and Co., makers of railway plant and weighing machinery. He was an original promoter of the Stockton and Middlesbrough Waterworks Company, and was one of those who profitted largely when they were purchased compulsorily by the Stockton and Middlesbrough Corporations. He leaves a widow and three grown-up sons.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

FROM the South Yorkshire collieries a heavy tonnage is being sent to the Humber ports. The quantity sent to Hull from the various ports in South and West Yorkshire last month was 101,876 tons, against 64,912 in January of last year. The exports show a marked increase last month, being 52,000 tons, against 34,450 tons in January, 1880. 15,419 tons were sent to Denmark, and 11,219 tons to Germany. Very little coal was sent to Russia. The Denaby Main heads the list of Yorkshire collieries, sending 12,024 tons to Hull last month, nearly 8000 tons of which were sent by water. Manver's Main Colliery was next with 3177 tons, of which 2704 were sent by water. Carlton Main has a dispute with the Midland, and in consequence nearly all its coal was sent by the canal—1276 tons by water and 847 by rail. The West Riding and Silkstone Collieries, on the other hand, sent 7006 tons all by rail, whilst Wharncliffe, Silkstone, supplied 4040 tons, all by water. Thrybergh Hall also sent 3640; Tankersley, 1344; Mount Osborne, 740; Aldwarke Main, 712; and Nostell, 388; all by water. Elsecar sent 2876 tons by water, and 3108 by rail.

The coal trade is much more languid, owing to the continuance of mild weather. House fuel is cheaper now than it has been for four years, and while the coalowner complains that he is getting less for his commodity, the consumer is not having the benefit of the lower values. Steam fuel is in fair request, but quotations keep low owing to contracts having been taken for six and twelve months. In two instances, where contracts have expired, an advance of 3d. and 6d. a ton has been secured.

At the Parkgate Ironworks a notice has been posted up that all tonnage wages that were reduced on August 1st, 1881, will now be advanced $7\frac{1}{2}$ per cent., and puddlers' wages are also raised 9d. per ton, the advance to date from January 30th, 1882.

Several local companies have issued their reports during the week. John Round and Son, Limited—silver-platers—pays $12\frac{1}{2}$ per cent., and carry forward £327. The North Central Wagon Company pays 8 per cent. The British Wagon Company, Limited, Rotherham, pays 6 per cent.

A new line of steamers, to be called the "Black Star Line," is being arranged to run between Grimsby and America. It is not yet decided whether the American port of call will be New York or Philadelphia. The vessels will probably be of 3000 tons burthen each, carrying merchandise and passengers. A call will be made each voyage at Southampton.

The electric light is making progress. The Grimsby Town Council, while considering the time has not yet arrived for the adoption of the electric light in the borough, have given instructions for the preparation of a Bill for this session empowering the corporation to provide the light for public and private purposes.

The order for steel rails mentioned last week as having been given by the Victorian Government should have been stated as 150,000 *pounds* in value, and not tons in weight.

Messrs. Joseph Rodgers and Sons, Limited, the well-known cutlery manufacturers, have again declared "the usual dividend," to quote the phraseology of the local papers. The usual dividend is $17\frac{1}{2}$ per cent. The shares are £100, fully paid up, and are now quoted at £250. At the annual meeting of shareholders on Wednesday the retiring directors—Mr. Wm. Watson and Mr. F. Bardwell—were re-elected.

The failure is announced this week of Messrs. Coupe, Addy, and Hall, manufacturers of wire, &c., British Steel and Iron Wire Works, Tinsley, near Sheffield. The liabilities are estimated at £5000. The failure is attributed to unremunerative contracts for wire for railway purposes.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE iron market has been comparatively steady during the past week, the variations in prices for the most part being unimportant. Towards the close of last week a large speculative business was done in warrants, but the transactions this week have been more of a jobbing nature. Although the market is quiet and prices comparatively low, a steady business is being done in the production and sale of iron, both for home and foreign consumption. The week's shipments, although not quite so large as they were in the preceding week, are heavier than usual at this season, and are regarded on the whole as tolerably satisfactory. Notwithstanding the high freights and other discouraging circumstances in connection with the American trade, a very good business is being done with the United States, and there appears a prospect of its improving. France and Italy are likewise taking fair quantities of Scotch pig iron. There is no change in the number of furnaces in blast, and but very little iron is being sent into store at present. An increasing quantity of No. 3 is being used in the manufacturing works, and the prices of this quality are comparatively good, while its extensive consumption has had much to do with keeping the stocks from increasing in the public stores.

Business was done in the warrant market on Friday forenoon at from 49s. to 48s. 10d. cash, 49s. 1d. eight days, and 49s. 3d. to 49s. $1\frac{1}{2}$d. one month, quotations in the afternoon being 48s. $10\frac{1}{2}$d. to 49s. 1d. cash, and 49s. 2d. to 49s. $3\frac{1}{2}$d. one month. On Monday the market was quiet, with business in the morning at from 48s. 10d. to 49s. 1d. cash, and from 49s. $1\frac{1}{2}$d. to 49s. $4\frac{1}{4}$d. one month; in the afternoon transactions were effected at 49s. 1d. to 48s. 11d. cash, and 49s. $3\frac{1}{2}$d. to 49s. $2\frac{1}{2}$d. one month. On Tuesday forenoon business was done at 49s. to 49s. 1d. cash, and 49s. $3\frac{1}{2}$d. to 49s. 4d. one month, the afternoon quotations being 49s. $0\frac{1}{2}$d. to 48s. 11d. and 49s. cash. The market was strong on Wednesday, with business up to 49s. 6d. cash and 49s. 9d. one month. To-day (Thursday) quotations were 49s. 4d. to 49s. 7d. cash and 49s. 9d. one month.

The question of the probable renewal of the agreement between the Scotch and Cleveland ironmasters for a restriction of their output of pig iron is at present engaging some attention. It may be remembered that the agreement, which dates from the 1st of October last year, was for six months, and as it will expire at the end of March, some of those concerned appear to be of opinion that it is now time to consider whether it is to be renewed at that date for a further period.

Although the shipments have been good, as mentioned above, the demand for makers' iron within the past few days has been somewhat limited, consequently the quotations are rather lower, as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 59s., No. 3, 52s.; Coltness, 59s. and 53s.; Langloan, 60s. and 55s.; Summerlee, 58s. 6d. and 50s. 6d.; Calder, 58s. 6d. and 52s.; Carnbroe, 54s. 6d. and 50s. 6d.; Clyde, 51s. 6d. and 49s.; Monkland, 50s. and 48s.; Quarter, 50s. and 48s.; Govan at Broomielaw, 51s. and 49s.; Shotts at Leith, 59s. 6d. and 55s.; Carron, at Grangemouth, 52s. 6d. (specially selected, 55s.) and 51s. 6d.; Kinneil, at Bo'ness, 50s. and 48s.; Glengarnock, at Ardrossan, 54s. and 51s.; Eglinton, 50s. and 48s.; Dalmellington, 50s. and 49s.

It may be worthy of note that the stock of pig iron in Messrs. Connal and Co.'s stores at present amounts to 631,000 tons, and exceeds that at the same time last year by 109,000 tons.

The malleable trade still continues very well employed, the works being engaged upon contracts secured some time ago. There has within the past week or two, however, been less inquiry for malleable iron, but there is no alteration in prices, although the feeling of the market is a little easier.

In the engineering trades there is hardly any abatement of the activity formerly reported. Shipbuilding orders have not been coming in so well of late, but still there is abundance of employment in the marine engineering department, and general engineers are better off for work than they have been for a number of years. Operations in the light foundry work have been much impeded by a strike of moulders which has lasted several weeks.

The coal trade is somewhat dull at the present moment compared with what it has been in some preceding weeks. The shipments from the different Scotch ports are not so large; still the trade is greater, perhaps, in volume than at any former time. A very extensive consumption of coal is going on at the ironworks, and the factories and public works of all descriptions require heavy supplies. There is no quotable change in prices.

The liquidators of the Benhar Coal Company, Limited, have issued a report to be submitted to a meeting at Edinburgh next week. They place the liabilities of the concern at £174,000, whereof £7000 are preferable, there being besides £13,000 of claims not included, which are in dispute. The assets, which consist of reversion of lands, accounts due to the company, arrears of calls and stocks of minerals, are estimated at not more than £70,000, leaving a balance of £104,000 which must be got for the collieries themselves to admit of payment of 20s. in the pound to creditors alone, without making provision for claims in dispute or liquidation expenses.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

THERE was an important meeting of freighters at Cardiff on Saturday, in attendance on Mr. W. T. Lewis, general manager of the docks, and Mr. Shirley, the legal representative of the Marquis of Bute and trustees. The object of the meeting was to elicit the views of Mr. W. T. Lewis with regard to the new dock. From the statement made by the spokesman of the freighters, it appeared to be their impression that the new dock contemplated was not so large as they were led to believe it was to be, nor was the site the same. Mr. Lewis said that the change of site was due entirely to a wish to facilitate the opening of the dock. The engineers, in reporting on the dock, had stated that at the site now proposed a dock could be formed in less than half the time that it would take if the opening were direct from the sea. Mr. Lewis further entered minutely into details, and showed convincingly to many present that the Marquis of Bute had kept good faith, and was only animated by a desire to further the interests of the freighters. Still the majority of the deputation appeared to think otherwise, and it was intimated that the bill would be opposed. Since that there has been a decided schism amongst the freighters. Several influential members have seceded from the opposition ranks, and now it is tolerably certain that if the bill be opposed by Cardiff freighters that opposition will be materially weakened by the lack of unanimity in the camp. The feeling awakened by Mr. J. O. Riches at the shipowners' meeting has materially subsided, and this to a large extent is due to a masterly letter issued by Mr. T. Joseph, in which he shows, as I attempted last week to prove, that there need be no fear of a failure of coal supply for a couple of hundred years.

Coedcae, to which is now joined the Havad, a deep-sea coal colliery in the Rhondda, was the scene of a fatal mishap on Saturday night. The Coedcae comprises its own area, that of the house coal, and the Havad, and thus is really an aggregate of three pits under the management of Mr. Wm. Davies, and has long been noted for the excellent way in which the management and engineering details has been carried out. But on Saturday, owing, it is feared, to entire obliviousness on the part of the sufferers who acted on their own wrong judgment, two men went down forty yards in the shaft to repair damages, the fan being stopped, and were aided by open lamps, called comets, fed with paraffin. It is supposed that the lamps leaked, and that the men in their oilskin clothes caught fire, for suddenly there was a cry of fire, and instantly an effort was made to raise the cage, but unsuccessfully, a plank obstructing it on the platform. At length the cage was raised, when the two men were found burnt to death. Simultaneously, the fan having been stopped, an explosion occurred in the shaft, and, in all, six victims have been killed. A close investigation is now being held.

The iron and coal trades are in vigorous action, and prices are firm. In coal 172,718 tons were sent away during last week from the several Welsh ports. Cardiff exceeded its previous week's total, and Swansea was fully up to its average. Swansea now slightly exceeds Newport. Last week Newport exported 26,776 tons and Swansea 27,522. The steady growth of the coal trade at Swansea, especially shown in its French trade, is very satisfactory. Tin-plate, however, is not quite up to the mark. Patent fuel, on the contrary, is a thriving industry, nearly 5000 tons having been dispatched during the week.

A large meeting of house colliers was held at Tredegar this week, and it was decided to co-operate with the Aberdare men in endeavouring to amend certain clauses of the sliding scale. There seems a strong disposition on the part of the majority to maintain a peaceful attitude.

Large supplies of foreign ore, principally from Bilbao, have come in during the week. There has been no indication given yet of a start at Cyfarthfa, but the satisfactory condition of present trade is regarded as a possible stimulus to a movement. In the Caerphilly district a large amount of good work is being done, and at Energlyn, which turns out a special gas coal, business is brisk.

The Penarth Iron and Steel Works, in liquidation, are to be put up for auction on the 1st of March. This will be an opportunity for those who think that the future site for iron and steel works is at the seaside.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

*** *It has come to our notice that some applicants of the Patent-office Sales Department, for Patent Specifications, have caused much unnecessary trouble and annoyance, both to themselves and to the Patent-office officials, by giving the number of the page of* THE ENGINEER *at which the Specification they require is referred to, instead of giving the proper number of the Specification. The mistake has been made by looking at* THE ENGINEER *Index and giving the numbers there found, which only refer to the pages, in place of turning to those pages and finding the numbers of the Specification.*

Applications for Letters Patent.

*** When patents have been "communicated" the name and address of the communicating party are printed in italics.

7th February, 1882.

578. ELECTRIC LAMPS, B. J. B. Mills.—(*W. Thomas, U.S.*)

579. GAS ENGINES, J. Johnson.—(*A. de Bischop, Paris.*)

580. FURNACES, W. Morgan-Brown.—(*A. Felton, U.S.*)

581. TREATING FIBROUS PLANTS, C. Ekman, London,

582. SEWING MACHINES, J. Hill, London.

583. TRICYCLES. B. Roberts, Wolverhampton.

584. BRAKE-BLOCKS, J. Heald, Cardiff.

585. METERS, W. Airy, London.

586. LASTS, J. L Sharman, Northampton.

587. WEIGHING MACHINES, J. Williams, jun., London.

588. TREATING GRAIN, W. B. Dell and J. F. Stewart, London, and E. Davies, New Brighton.

589. REFRIGERATORS, &c., G. Lawrence, London.

590. REEDS, W. R. Lake.—(*M. Bray, Boston, U.S.*)

591. SECURING STOPPERS, W. R. Lake.—(*C. Renauld and M. B. Stafford, New York.*)

592. TREATING GRAIN, J. A. A. Buchholz, London.

593. TREATING COAL, T. Rowan, London.

594. WASHING, &c., FABRICS, H. L. Wilson and J. Clegg, Clayton-le-Moors, near Accrington.

595. WELDED BOILERS, Z. Sugden & E. Binns, London.

596. DELIVERING PAPER from MACHINES, W. C. Pellatt, London.

597. FASTENING LIDS of CANS, E. G. C. Bomford, Fladbury, near Pershore.

598. BREAD-MAKING, A. M. Clark.—(*T. Poupon, Paris.*)

599. SIGNALS, A. Gough, Buckingham.

8th February, 1882.

600. TRICYCLES, J. G. Smith, Eccles.

601. RIBBED FABRICS, C. H. Openshaw and C. H. Rothwell, Bury.

602. JOINTS, &c., H. J. Haddan.—(*Dr. Kraus, Vienna.*)

603. PROPELLERS, G. C. Parini, Lombardy, Italy.

604. DECORATING PLANTS, A. Berthet, Paris.

605. REFRIGERATING MACHINERY, G. Barker.—(*J. Chambers, Te Mata, New Zealand.*)

606. FLUID METER, C. D. Abel.—(*A. Kaiser, Berlin.*)

607. TELEPHONE TRANSMITTERS, R. and M. Theiler, Canonbury-road, London.

608. TRICYCLES, J. Beeston, Lymington.

607. CRIMPING, &c., CARTRIDGE CASES, W. W. Greener, Birmingham.

610. WATCHMAKERS' TOOLS, D. Petitpierre, Couvet.

611. CAPSULES for BOTTLES, E. Belmer, London.

612. TREATING DANGWAY BEANS, R. R. Carew.—(*E. B. Sladen, R. McLeod, and C. H. White, India.*)

613. SIGNALLING, J. White, London.

614. GAS ENGINES, W. Haigh and J. Nuttall, Oldham.

615. DOOR, &c., FRAMES, J. H. Miles, Southampton.

616. PURIFYING MIDDLINGS, W. R. Lake.—(*Electric Purifier Company, Incorporated, New Haven.*)

617. BREECH-LOADING FIRE-ARMS, W. M. Scott, Birmingham, and T. Baker, Aston.

618. BICYCLES, G. W. Ash, Southsea.

619. EXPLOSIVES, W. F. Reid, Stowmarket, and D. Johnson, Chester.

620. TRIPLE ALLOYS of MANGANESE, G. Scott, London.

621. ELECTRIC CURRENTS, J. B. Rogers, London.

622. LEATHER SOLES, E. A. Brydges.—(*Heller and Atzler, Potschappel, Germany.*)

9th February, 1882.

623. STOVES, H. Leggott, Bradford, & E. Marsh, Leeds.

624. COUPLING APPARATUS, &c., S. J. Humble and J. Walker, Derby.

625. OPEN FIRE-GRATES, J. Winfield, Derby.

626. ELECTRIC LAMPS, A. A. Common, London.

627. COLOURING MATTERS, J. A. Dixon.—(*Dr. C. Koenig, Germany.*)

628. TWIN-SCREW SHIPS, T. R. Oswald, Southampton.

629. SIGNALLING, J. W. Webster, Littleborouge, J. Hill, Rochdale, and T. and F. Greenwood, Lancaster.

630. LAMPS, S. Pitt.—(*H. Peigniet, Paris.*)

631. CORSETS, &c., A. Wardrop, London.

632. SIGNALLING, S. C. C. Currie, London.

633. ANTI-CORROSIVE WRAPPINGS, A. Riegelmann, Hanau, Prussia.

634. FACING, &c., WALLS, T. Brindle, Southport.

635. STEAM BOILERS, W. Arnold, Barnsley.

636. PORTABLE URINAL, E. S. and E. Howell, London.

637. SHAFT COUPLINGS, W. R. Lake.—(*F. O. Deschamps, E. L. Clark, and E. H. Burr, U.S.*)

10th February, 1882.

638. REFRIGERATING APPARATUS, J. Coleman, Glasgow.

639. FURNACES, J. Wood and J. Greenwood, Oldham.

640. STAMPING LETTERS, J. G. A. Haller, Hamburg.

641. PRESSES, S. Mart, Sutton-at-Hone, and C. W. Bradley, London.

642. BREAD, J., D. J. and J. Beatty, Belfast.

643. SAFETY TAP, J. W. Plunkett, London.

644. BRACES, J. H. Johnson.—(*J. C. Garand, Paris.*)

645. PURIFYING, &c., IRON, R. Thompson, Wigan.

646. PROTECTING WOOD, &c., from FIRE, H. H. Lake.—(*J. Wildi, Switzerland, and J. Schambeck, Bavaria.*)

647. PREVENTING the FOULING of the INSIDE of PIPES, C. Slagg, Leeds.

648. MUSICAL INSTRUMENTS, H. J. Haddan.—(*W. F. Abbot, Montreal, Canada.*)

649. TIP WAGONS, J. Watling and E. Chaston, London.

650. VELOCIPEDES, H. A. Dufrené.—(*A. Mange, France.*)

651. ERASING KNIVES, &c., C. H. Wood, Sheffield.

652. LIFTING STONES, &c., J. Stainer, Heckmondwike.

653. BLEACHING, J. Young, Kelly.

654. LINING CHIMNEYS, T. Fraser, Aberdeen.

655. CUTTING, &c., EARTHY MATERIALS, P. W. D'Alton, London.

656. SUPPLY, &c., APPARATUS, A. Brossard, Swansea.

657. ANVILS, E. and O. Wright, Dudley.

658. SLABS or PANELS, A. McLean, London.

659. GAS ENGINES, E. S. Wastfield, Bath.

11th February, 1882.

660. WASHING, &c., SILKS, N. Bradley, Manchester.

661. TELEPHONE EXCHANGE APPARATUS, H. H. Eldred.—(*T. B. Doolittle, Bridgeport, U.S.*)

662. TAPS and VALVES, G. Heidmann, Elberfeld, and Y. Hoffman, Uerdingen, Prussia.

663. SLIDING WINDOWS, J. F. Williams, Liverpool.

664. CORSETS, &c., T. H. Harrison, Derby.

665. INJECTING, &c., APPARATUS, H. A. Bonneville.—(*J. A. Joltrain, France.*)

666. CLAY, H. J. Haddan.—(*F. Cancalon, France.*)

667. PURIFYING LIQUIDS, H. J. Haddan.—(*H. Tietz, Germany.*)

668. SET-SQUARES, G. W. von Nawrocki.—(*T. Redlich, Germany.*)

669. DISTILLING ALCOHOL, P. Claes, Brussels.

670. SHIRTS, C. Tighe, London.

671. DOOR-MAT and SCRAPER, J. S. Willway, Bristol.

672. WELDING METALS, C. D. Abel.—(*J. Laffitte, Paris.*)

673. AIR-REFRIGERATING APPARATUS, T. B. Lightfoot, London.

674. STARTING FRESHLY LIGHTED FIRES, A. J. Boult.—(*J. Hahn, Germany.*)

675. RAISING, &c., WEIGHTS, J. C. Mewburn.—(*A. Ballier, France.*)

672. SUGAR, C. Scheibler, Berlin.

667. INTERLOCKING SIGNALLING APPARATUS, W. E. Langdon, Derby.

668. GAS ENGINES, W. Watson, Leeds.

669. HORSESHOES, J. Gavett, London.

680. SLIDE-VALVES, D. Ashton, Sheffield.

681. HINGES, J. W. Pitt, Loversedge.

682. INTRODUCING ANTI-INCRUSTATION MATERIAL into BOILERS, J. Trotter, Rawtenstall.

683. ROLLER BEARINGS, A. Burdess, Coventry.

684. SUSPENDING WALL-PAPER. A. M. Clark.—(*H. Staib, New York.*)

685. RAISING WATER, A. Clark.—(*J. Decoudun, Paris.*)

682. TELEPHONE CALL, &c., APPARATUS, A. M. Clark.—(*G. M. Hopkins, Brooklyn, U.S.*)

687. TELEPHONE EXCHANGE SYSTEMS, A. M. Clark.—(*G. M. Hopkins, Brooklyn, U.S.*)

688. TRANSMITTING, &c., SOUNDS by ELECTRICITY, A. M. Clark.—(*G. M. Hopkins, Brooklyn, U.S.*)

689. TELEPHONE RECEIVERS, A. M. Clark.—(*G. M. Hopkins, Brooklyn, U.S.*)

13th February, 1882.

690. FASTENING RAILS, G. Schwartzkoppf, Berlin.

691. FIRE-BARS, S. Barlow, Castleton.

622. WINDING APPARATUS, H. J. Haddan.—(*A. Lausies, France.*)

693. ROLLER MILLS, J. Qualter, Barnsley.

694. FIRE-BOXES, R. Brandon.—(*P. Nepilly, Germany.*)

695. PIPES, C. Morris, London.

696. TREATING METALS, A. M. Clark.—(*L. Clémandot, Paris.*)

697. HORSESHOES, G. Collier, Newcastle-upon-Tyne, and W. Armes, Norwich.

698. TRANSPORT of PASSENGERS, P. Everitt, London.

699. LOOMS, J. Hollingworth, Dobcross.

700. GENERATING, &c., ELECTRICITY, J. Willams, U.S.

701. FIRE-SCREEN MOUNT, H. J. Davis, London.

702. BLOWING, FLUIDS, H. Wilson, Stockton-on-Tees.

Inventions Protected for Six Months on Deposit of Complete Specifications.

616. PURIFYING MIDDLINGS, W. R. Lake, Southampton-buildings, London.—A communication from the Electric Purifier Company, Incorporated, New Haven, U.S.—*8th February*, 1882.

650. VELOCIPEDES, H. A. Dufrené, Finsbury, London.—A communication from M. A. Mange, Lonchamp, France.—*10th February*, 1882.

Patents on which the Stamp Duty of £50 has been paid.

490. BATCHING, &c., JUTE, F. S. Sandeman and J. McLean, Dundee.—*7th February*, 1879.

591. IRON and STEEL, H. G. Harmet, Denain, France.—*14th February*, 1879.

594. HYDROGEN GAS, E. G. Brewer, London.—*14th February*, 1879.

706. BREECH-LOADING SMALL-ARMS, J. V. Needham, Birmingham.—*21st February*, 1879.

759. PAPER BAGS, T. Coates and J. J. Bissicks, Bristol.—*25th February*, 1879.

516. DISH or PAN, G. Mander, Birmingham.—*10th February*, 1879.

3273. BLEACHING WOOD PULP, F. Wirth, Frankfort-on-the-Maine, Germany.—*13th August*, 1879.

3766. DRYING PAPER, &c., T. Wirth, Frankfort-on-the-Maine, Germany.—*19th September*, 1879.

518. ASTRONOMICAL APPARATUS, E. G. Brewer, London.—*10th February*, 1879.

519. LOOMS, J. Bywater and C. Bedford, Birstal, near Leeds.—*10th February*, 1879.

538. SEWING SHEETS of PAPER TOGETHER, D. M. Smyth, East Northwood, U.S.—*11th February*, 1879.

551. ROLLER MILLS, J. W. Throop, London.—*12th February*, 1879.

570. GLAZING ROOFS, T. W. Helliwell, Brighouse.—*13th February*, 1879.

734. CHAIR SLEEPERS, W. G. Olpherts, London.—*17th February*, 1879.

651. REGULATING the SUPPLY of STEAM to ENGINES, F. W. Durham, Barnet.—*18th February*, 1879.

517. GRINDING and POLISHING, R. J. Edwards, London.—*10th February*, 1879.

539. LAMPS, C. F. A. Hinrichs, Brooklyn, New York.—*11th February*, 1879.

563. VENTILATOR, J. Gilmore and W. R. Clark, Lower Norwood.—*12th February*, 1879.

664. FOOD FOR HORSES, E. Wilam, London.—*19th February*, 1879.

Patents on which the Stamp Duty of £100 has been paid.

463. STRAW HATS, W. Clark, Chancery-lane, London. *6th February*, 1875.

479. STEAMING PRINTED FABRICS, H. F. A. Cordillot, Sepouchoff, near Moscow, and W. Mather, Salford.—*9th February*, 1875.

489. HORSESHOE, &c., NAILS, J. R. Heard, Boston.—*10th February*, 1875.

502. FERTILISERS, B. Akerman, New York.—*10th February*, 1875.

514. FLOATING DOCKS and PONTOONS. J. L. Clark and J. Standfield, London.—*11th February*, 1875.

525. ELECTRIC TELEGRAPHS, G. Allan and J. W. Brown, London.—*12th February*, 1875.

490. STOPPERS for BOTTLES, L. Vallet, Liverpool.—*10th February*, 1875.

511. FURNACES, C. J. Schofield, Clayton, near Manchester.—*11th February*, 1875.

Notices of Intention to Proceed with Applications.

Last day for filing opposition 3rd March, 1882.

3543. STEAM ENGINES, E. A. Brydges, Upton.—Com. from H. de Grousilliers.—*16th August*, 1881.

4310. SECONDARY BATTERIES, A. P. Laurie, Nairne Lodge, Duddingstone.—*4th October*, 1881.

4324. FLUID METERS, A. Wightman, Sheffield.—*5th October*, 1881.

4343. EXTINGUISHING FIRE, J. Dutton, Bermondsey.—*6th October*, 1881.

4347. FIRE-BOXES, J. Shepherd, Manchester. — *6th October*, 1881.

4348. LOOMS, G. Kirk, Huddersfield.—*6th October*, 1881.

4353. PREPARING WOOL, &c., J. Tatham, Rochdale.—*6th October*, 1881.

4354. SCREW PROPELLERS, J. Carr, Heaton. — *6th October*, 1881.

4362. BORING and TAPPING APPARATUS, A. Upward, Westminster.—*7th October*, 1881.

4365. ASSISTING VISION, P. Adie, Pall Mall, London.—*7th October*, 1881.

4372. CUTTING SHIVES, E. J. Heal, Old St. Pancras-road, London.—*7th October*, 1881.

4374. EXHIBITING PHOTOGRAPHS, &c., R. Love, Hatton-garden, London.—*8th October*, 1881.

4375. TIMEKEEPERS, &c., H. B. James, Gray's-inn-road, London.—*8th October*, 1881.

4384. BASIC BRICKS, S. G. Thomas, Tedworth-square, London.—*8th October*, 1881.

4389. DYEING, &c., COMPOUNDS, R. H. C. Neville, Lincoln.—*8th October*, 1881.

4391. ATTACHING DOOR KNOBS, B. W. Spittle, Wednesbury.—*10th October*, 1881.

4397. MAGNESIA, T. Twynam, Addison-gardens, London.—*10th October*, 1881.

4400. PADS for HORSES' FEET, W. Reynolds, Oxford-street, London.—*10th October*, 1881.

4403. FIRE-LIGHTER, A. G. Elliott, Southampton-buildings, London.—*10th October*, 1881.

4400. KNITTED or LOOPED FABRICS, T. Thorpe, New Basford.—*11th October*, 1881.

4410. DRESSING, &c., WOODEN HOOPS, W. Morgan-Brown, London.—A communication from H. F. Campbell.—*11th October*, 1881.

4415. CORVES or WAGONS, R. Hadfield, Southampton-buildings, London.—*11th October*, 1881.

4426. KNITTING MACHINES, H. J. Haddan, London.—Com. from R. I. Creelman.—*11th October*, 1881.

4452. COUPLINGS, &c., W. L. Wise, London.—Com. from L. Mégy and J. de Echeverria.—*12th October*, 1881.

4461. METAL KEGS, J. Storer, Barrowfield. — *13th October*, 1881.

4470. FURNITURE, J. Middleton and G. J. Scott Birkenhead.—*13th October*, 1881.

4474. MOTORS, W. L. Wise, London.—A communication from L. Mégy.—*13th October*, 1881.

4495. LOOMS, W. E. Gedge, London.—A communication from J. Vacher.—*15th October*, 1881.

4510. GOVERNORS for ENGINES, P. Turner, Ipswich.—*15th October*, 1881.

4546. STEAM BOILERS, E. Crompton and J. T. Cochran, Birkenhead.—*18th October*, 1881.

4593. CLEANING GRITS, A. Besser, Vienna.—*20th October*, 1881.

4604. FINISHING CORN, E. Foden, Sandbach. — *21st October*, 1831.

4762. ENAMELS, C. W. Heaton, Lessness Heath, and T. Bolas, Chiswick.—*31st October*, 1881.

4826. SPRING MATTRESSES, G. Lowry, Salford.—*3rd November*, 1881.

4982. MARKING KEY-GROOVES, J. Roemmele, Glasgow—*14th November*, 1881.

5233. ELECTRICITY, W. R. Lake, London.—A communication from J. S. Williams.—*30th November*, 1881.

5389. METALLIC ALLOYS, G. A. Dick, Cannon-street, London.—*9th December*, 1881.

5397. HEATING AIR and GASES, W. Whitwell, Stockton-on-Tees.—*9th December*, 1881.

5716. ROASTING COFFEE, &c., M. Robinson, Manchester.—*30th December*, 1881.

5730. BRUSHES, G. J. Beissbarth, London.—A communication from J. M. Beissbarth.—*30th December*, 1881.

95. ELECTRIC LAMPS, W. J. Mackenzie, Glasgow.—*7th January*, 1882.

107. TENTERING, &c., MACHINES, J. Ashworth, Roch dale.—*9th January*, 1882.

157. ELECTRIC LIGHTING, G. Hawkes, Victoria-cham bers, Westminster.—*11th January*, 1882.

Last day for filing opposition, 7th March, 1882.

4382. PERAMBULATORS, C. H. Brassington, Manchester—*8th October*, 1881.

4393. SAFETY VALVES, C. Shields, Manchester.—*10th October*, 1881.

4399. FEEDING APPARATUS, J. and A. Leadbeater Morley.—*10th October*, 1881.

4402. MOTOR ENGINES, G. W. Weatherhogg, Birmingham.—*10th October*, 1881.

4411. FALSE BOTTOM for MASH TUNS, &c., G. G. Cave, Bristol.—*11th October*, 1881.

4417. MUSIC and READING STAND, J. J. Gilbert, New Romney.—*11th October*, 1881.

4425. HEATING APPARATUS, T. Stokoe, Headingley.—*11th October*, 1881.

4428. TELEPHONIC APPARATUS, A. R. Bennett, Forest-gate, London.—*11th October*, 1881.

4443. WORT, T. Webb, Clapton Park, London.—*12th October*, 1881.

4453. LOCKS or DAMS, J. M. Bibbins, London.—A communication from J. Du Bois.—*12th October*, 1881.

4459. GRINDING CURLING STONES, A. Kay, Mauchline.—*13th October*, 1881.

4519. CARRIAGE AXLE-CLIPS, G. Wearing, West Bromwich.—*17th October*, 1881.

4525. ENGINES, A. W. L. Reddie, London.—A communication from the Pneumatic Tramway Engine Company (Incorporated).—*17th October*, 1881.

4537. FEED-WATER APPARATUS, S. Hallam and J. W Shepherd, Manchester.—*18th October*, 1881.

4538. DECORTICATING MACHINE, J. C. Mewburn, London.—Com. from J. B. Sauvadon.—*18th October*, 1881.

4555. OZONISED OXYGEN, E. Hagen, Ealing.—A communication from L. and A. Brin.—*18th October*, 1881.

4565. SUPPLYING WATER to HOUSES, &c., W. M. Farley and J. H. Bond, Torquay.—*19th October*, 1881.

4577. TREATING IRON, P. Jensen, London.—Com. from Count Montblanc and L. Gaulard.—*19th October*, 1881.

4584. BOXES, &c., W. H. Bennett, Covent-garden, London.—*20th October*, 1881.

4642. VACUUM BRAKE APPARATUS, J. Gresham, Salford—*24th October*, 1881.

4798. STEAM BOILERS, G. Kamensky, London.—Com. from D. Novikoff.—*2nd November*, 1881.

4800. REMOVING NIGHT SOIL, &c., A. M. Clark, London.—A communication from the Compagnie Générale de Salubrité.—*2nd November*, 1881.

4942. ELECTRIC CURRENTS, S. Pitt, Sutton.—Com. from L. Caulard and J. D. Gibbs.—*11th November*, 1881.

4980. EMBROIDERING MACHINES, A. M. Clark, London.—Com. from Ferry and Millet. -*14th November*, 1881.

5315. FIXING WINDOW GLASS, W. Clark, London.—Com. from T. Tanner.—*5th December*, 1881.

5468. TELEGRAPH, &c., CONDUCTORS, J. Imray, London.—Com. from J. M. Stearns.—*14th December*, 1881.

5625. COOLING AIR, J. J. Coleman, Glasgow.—*23rd December*, 1881.

5723. FEEDING HURDLES, A. J. Scott, Rotherfield.—*30th December*, 1881.

29. SECONDARY BATTERIES, D. G. FitzGerald, Brixton, and C. H. W. Biggs and W. W. Beaumont, Strand London.—*3rd January*, 1882.

44. CURING NEURALGIA, &c., H. F. Mills, Notting-hill London.—*4th January*, 1882.

115. WASHING APPARATUS, W. Birch, Salford.—*9th January*, 1882.

152. DYEING, &c., E. Boden, Manchester. — *11th January*, 1882.

159. BOXES, S. Wood, Cleckheaton.—*12th January*, 1882.

183. BUTTONS, W. Willeringhaus, Hamsell-street, London.—*13th January*, 1882.

191. BRAKE APPARATUS, C. D. Abel, London.—Com. from G. Westinghouse, jun.—*13th January*, 1882.

202. TREATING AMMONIA, A. McDougall, Penrith.—*14th January*, 1882.

249. CLEANING BOOTS and SHOES, G. H. Ellis, London.—*18th January*, 1882.

380. PIANO and ORGAN PLAYERS, C. N. Andrews, San Francisco.—*25th January*, 1882.

384. ANILINE, &c., W. R. Lake, London.—A communication from E. D. Kendall.—*25th January*, 1882.

507. CLOCKS, H. H. Lake, London.—A communication from A. M. Lane.—*1st February*, 1882.

Patents Sealed.

(*List of Patent Letters which passed the Great Seal on the 10th February*, 1881.)

2935. WINDOW-CLEANING, &c., S. Krakauer, Swan-street, London.—*5th July*, 1881.

3495. METALLIC SPRING MATTRESSES, S. Knowles, Manchester.—*12th August*, 1881.

3507. PLASTERING MOULDS, E. G. Brewer, Chancery lane, London.—*12th August*, 1881.

3509. ELECTRICAL INTERRUPTORS, P. Ullathorne, High Holborn, London.—*12th August*, 1881.

3512. STOVES and FIRE-PLACES, T. Redmayne, Sheffield.—*12th August*, 1881.

3515. DOWNCAST VENTILATING COWLS, J. W. Gibbs Liverpool.—*13th August*, 1881.

3533. CRINOLINES, C. S. Schneider, Chelsea. — *16th August*, 1881.

3554. TOBACCO-PIPE, H. Woodward, Shepherd's-bush London.—*16th August*, 1881.

3555. CONVEYING MESSAGES, &c., from SHIPS, H. Red knap, Twickenham.—*16th August*, 1881.

3557. CHECK-ACTION, &c., for PIANOFORTES, J. Brinsmead, London.—*16th August*, 1881.

3568. CONCERTINAS, &c., B. Berry, Gosforth.—*17th August*, 1881.

3583. SUGAR-CANE MILLS, D. Stewart, Glasgow.—*17th August*, 1881.

3616. FORKS, &c., G. R. Postlethwaite, Aston.—*19th August*, 1881.

3662. CONTROLLING FEED-WATER, M. Benson, Chancery lane, London.—*23rd August*, 1881.

3664. PHOTOGRAPHIC PICTURES, P. M. Justice, London.—*23rd August*, 1881.

3669. POCKET-BOOKS, &c., W. R. Lake, London.—*23rd August*, 1881.

3678. POLISHING APPARATUS, E. W. Lay and S. Martin, Hampstead.—*23rd August*, 1881.

3696. Electro-magnetic Clocks, &c., C. Shepherd, South Hampstead.—24th August, 1881.
3703. Securing Rails in Chairs, T. Matthews, Stoke Newington.—25th August, 1881.
3712. Ammonia, C. D. Abel, Southampton-buildings, London.—25th August, 1881.
3720. Stoppering Bottles, W. R. Lake, Southampton-buildings, London.—25th August, 1881.
3721. Rope and Hawser Stoppers, T. Edmond, Plymouth.—25th August, 1881.
3741. Refrigerating Apparatus, O. Möcke, Leipsic.—27th August, 1881.
3744. Bicycles, &c., E. C. F. Otto, Peckham.—27th August, 1881.
3745. Etching Glass, J. Fahdt, Dresden.—27th August, 1881.
3749. Barrows, B. Green, Mitcham.—27th August, 1881.
3781. Velocipedes, J. White, Earlsdon, and J. Asbury, Coventry.—30th August, 1881.
3789. Stentering, &c., Fabrics, C. A. Barlow, Manchester.—31st August, 1881.
3808. Conveying Sound, C. D. Abel, Southampton-buildings, London.—1st September, 1881.
3809. Telephonic Exchanges, C. D. Abel, Southampton-buildings, London.—1st September, 1881.
3856. Artificial Fuel, W. P. Thompson, Liverpool—5th September, 1881.
4032. Sewing Machines, C. A. Snow, Washington, U.S.—19th September, 1881.
4171. Cranes, C. R. Parkes, East Ferry-road, Millwall.—27th September, 1881.
4218. Treating Mineral Pyrites, &c., J. R. Francis, Swansea.—30th September, 1881.
4352. Axle-boxes, G. E. Vaughan, Chancery-lane, London.—6th October, 1881.
4666. Mincing Apparatus, C. M. Sombart, Magdeburg.—25th October, 1881.
4866. Voltaic Batteries, T. Coad, South-street, Finsbury, London.—7th November, 1881.
4867. Cabinet, T. Coad, South-street, Finsbury, London.—7th November, 1881.
4934. Frictional Coupling, W. J. Fraser, Haverstock-hill.—12th November, 1881.
5313. Mules for Spinning, B. A. Dobson, Bolton.—5th December, 1881.
5330. Combing Machines, B. A. Dobson and J. Macqueen, Bolton.—6th December 1881.
5331. Openers and Scutchers, B. A. Dobson and T. Wood, Bolton —6th December, 1881.
5335. Pillow Lace, W. Lake, Southampton-buildings, London.—6th December, 1881.
5464. Distilling Alcohol, K. Trobach and A. Cords, Berlin.—14th December, 1881.
5570. Compound Engines, A. M. Clark, Chancery-lane, London.—20th December, 1881.
5602. Files, A. M. Clark, Chancery-lane, London.—21st December, 1881.

List of Letters Patent which passed the Great Seal on the 14th February, 1882.)

3537. Moulding Flasks, &c., J. S. Campbell, New York.—15th August, 1881.
3538. Registering Apparatus, J. Porritt, Milnsbridge.—15th August, 1881.
3546 Diffusing Water Spray or Mist, G. W. von Nawrocki, Berlin.—16th August, 1881.
3547. Sewing Machines, A. François, Douai.—16th August, 1881.
3561. Propelling Motors, &c., A. H. V. de Kerkhove and T. Snyers, Brussels.—16th August, 1881.
3566. Pulverising Clay, &c., J. C. Anderson, Chicago, U.S.—16th August, 1881.
3569. Checking, &c., Apparatus, A. J. T. Wild, Nunhead.—17th August, 1881.
3570. Preparing Paper for Lithography, D. Bogue and B. C. Le Moussu, London.—17th August, 1881.
3576. Velocipedes, M. A. Wier, Gracechurch-street, London.—17th August, 1881.
3579. Protecting Ships, &c., B. L. Thomson, London.—17th August, 1881.
3584. Sulphur, &c., W. Clark, Chancery-lane, London.—17th August, 1881.
3618. Cricket Bats, G. W. Frowd, Newington-causeway, London.—19th August, 1881.
3621. Automatic Air-compressing Machines, V. C. Haurie, London.—19th August, 1881.
3622. Hot-air, &c., Machines, V. C. Haurie, London.—19th August, 1881.
3624. Utilising Locusts and other Insects, W. Clark, London.—19th August, 1881.
3625. Pickers, &c., I. and A. Wallwork, Ashton-under-Lyne.—20th August, 1881.
3629. Baths, C. Drake, Battersea.—20th August, 1881.
3630. Facing Bricks, C. Drake, Battersea.—20th August, 1881.
3652. Coiling Machine, C. L. Clarke and J. Leigh, Manchester.—22nd August, 1881.
3697. Bicycle Lamp, G. R. Godsall and J. C. C. Read, Birmingham.—25th August, 1881.
3701. Bending Rails, &c., J. H. Johnson, London.—25th August, 1881.
3714. Furnaces, &c., T. Barrow, Rock Ferry.—25th August, 1881.
3715. Gas Engines, H. Williams, Southport.—25th August, 1881.
3728. Ozonised Oxygen, E. Hagen, Ealing.—26th August, 1881.
3747. Ring-spinning Machines or Frames, W. R. Lake, London.—27th August, 1881.
3771. Voltaic Electricity, A. Banks, Birmingham.—30th August, 1881.
3783. Furnaces, J. H. Johnson, Lincoln's-inn-fields, London.—30th August, 1881.
3824. Utilising Volatile Products, J. Wetter, New Wandsworth.—2nd September, 1881.
3831. Milking Cows, A. B. Crees, Ilminster.—2nd September, 1881.
4235. Pumps, H. J. Haddan, Kensington, London.—30th September, 1881.
4268. Traction Engines, W. Wilkinson, Wigan.—1st October, 1881.
4434. Tricycles, A. M. Clark, Chancery-lane, London.—11th October, 1881.
5196. Cocks and Valves, D. R. Ashton, Clapton, and J. N. Sperryn, Brixton-hill.—28th November, 1881.
5463. Dies, W. R. Lake, Southampton-buildings, London.—14th December, 1881.
5569. Revolving Cylinder Fire-arms, W. R. Lake, London.—20th December, 1881.
5579. Iron, C. Semper and C. Fahlberg, Philadelphia, U.S.—20th December, 1881.
5589. Refining Impure Copper, H. H. Lake, London.—21st December, 1881.

List of Specifications published during the week ending February 11th, 1881.

1739*, 6d.; 4142*, 4d.; 2003*, 6d.; 4043*, 4d.; 781*, 6d.; 129*, 4d.; 902, 2d.; 1031, 6d.; 1350, 2d.; 1586, 2d.; 1644, 2d.; 1716, 2d.; 1742, 2d.; 1792, 2d.; 1880, 2d.; 2018, 2d.; 2046, 2d.; 2052, 2d.; 2082, 2d.; 2158, 6d.; 2186, 2d.; 2228, 2d.; 2238, 2d.; 2278, 6d.; 2482, 8d.; 2496, 2d.; 2664, 2d.; 2702, 2d.; 2712, 2d.; 2744, 6d.; 2777, 6d.; 2808, 6d.; 2826, 6d.; 2828, 6d.; 2834, 6d.; 2844, 2d.; 2845, 6d.; 2855, 6d.; 2859, 6d.; 2860, 6d.; 2866, 2d.; 2867, 6d.; 2868, 2d.; 2869, 6d.; 2878, 4d.; 2882, 4d.; 2890, 6d.; 2892, 4d.; 2897, 6d.; 2898, 6d.; 2900, 6d.; 2902, 2d.; 2909, 6d.; 2910, 6d.; 2913, 2d.; 2922, 2d.; 2925, 2d.; 2944, 6d.; 2972, 4d.; 3001, 6d.; 3004, 6d.; 3006, 6d.; 3017, 2d.; 3026, 2d.; 3029, 4d.; 3033, 2d.; 3035, 2d.; 3047, 2d.; 3060, 2d.; 3062, 4d.; 3063, 4d.; 3070, 2d.; 3071, 2d.; 3072, 4d.; 3073, 2d.; 3075, 2d.; 3076, 4d.; 3077, 2d.; 3084, 2d.; 3085, 2d.; 3087, 2d.; 3088, 2d.; 3096, 2d.; 3097, 2d.; 3098, 2d.; 3780, 6d.; 4170, 6d.; 4211, 6d.; 4910, 6d.

₊ Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane London.

ABSTRACTS OF SPECIFICATIONS.

Prepared by ourselves expressly for The Engineer *at the office of Her Majesty's Commissioners of Patents.*

902. Public Vehicles, *C. Gülich, Berlin.—2nd March,* 1881.—*(Provisional protection not allowed.)* 2*d.*
This relates to means for providing efficient ventilation of vehicles.

910. Metallic Pens, *M. Turner, Birmingham.—3rd March,* 1881. 6*d.*
This consists in making at the point of the pen an enlargement, which is connected to the nibs of the pen by means of a contraction or neck.

1031. Attaching Door or Other Knobs or Handles to their Spindles, *G. Price, Birmingham.—10th March,* 1881. 6*d.*
Inside the neck of the knob a rack is secured, and on the spindle is a spring to engage with such rack and spring over the teeth when pressed inwards. To remove the spindle a bradawl is inserted through a hole in the neck of the knob, and presses down the spring so as to disengage it from the rack.

1050. Water-closets, &c., *W. B. Bryan, Blackburn.—11th March,* 1881.—*(Provisional protection not allowed.)* 2*d.*
This consists in flushing water-closets with slop water and other waste water, instead of using water from the service main.

1453. Interlocking of Railway Telegraphic Block Instruments, &c., *C. Hodgson, Kilburn.—2nd April,* 1881. 8*d.*
This relates to improvements on patent No. 4170, 1879, and provides against negligence in the use of the instruments, and permits the working in both directions to be carried out with a single line.

1586. Preservation of Alimentary Substances, *G. M. Allender, Bayswater.—12th April,* 1881.—*(Provisional protection not allowed.)* 2*d.*
This relates to preserving alimentary substances by the use of metaphosphoric acid, orthophosphoric acid, or other form of phosphoric acid.

1644. Cast Crucible Steel, *J. H. Wilson, Liverpool.—14th April,* 1881.—*(Provisional protection not allowed.)* 2*d.*
Superior ore, such as Spanish hematite ore, is smelted in the usual way in a blast furnace, and the crude iron so produced is refined previous to puddling in an ordinary reverberatory furnace, the bottom and sides of its hearth being lined with iron ore. The furnace is strongly heated and the bottom of the hearth covered with finely pulverised ore, equal in weight to about 10 per cent. of the metal to be refined, which is then run in and gently stirred.

1716. Ammonia, *J. Storer, Glasgow.—20th April,* 1881.—*(Provisional protection not allowed.)* 2*d.*
Liquids containing nitrogenous matter are subjected to the action of rotating propellers or pulverisers, which cause air to be forcibly mixed and agitated with the liquid. The air, gas, or vapour which separates from the liquid is conducted to condensers in which the ammonia is absorbed.

1742. Drying Grain and Making Malt, *E. E. T. Mew, Newport, Isle of Wight.—22nd April,* 1881.—*(Provisional protection not allowed.)* 2*d.*
The malt or grain is placed in a rotary vessel, and to it air is admitted to dry the same.

1792. Discharging Condensed Water from Steam Pipes, *H. G. Grant, Manchester.—26th April,* 1881.—*(A communication from E. Briart, Jeumont, France.)—(Provisional protection not allowed.)* 2*d.*
A hollow ball is mounted on a counterbalanced lever, and serves to open and close a valve, through which the condensed water escapes.

1880. Application of Metallic and other Powders upon Straw Hats or Bonnets, *M. Andrieux, Neuilly, France.—2nd May,* 1881.—*(Provisional protection not allowed.)* 2*d.*
An adhesive mixture consisting of soap, oil, varnish, and starch is spread on the straw, and the powders sprinkled over it.

2018. Railway Carriages, *G. D. Peters, London.—9th May,* 1881.—*(Provisional protection not allowed.)* 2*d.*
The interior of the carriages is lined with vitrified material, so as to facilitate cleaning, and flexible partitions are provided, so that any part of the carriage may be cut off from the remainder. Water is supplied to carriage lavatories by means of compressed air from a cistern below the vehicle.

2046. Fastener for Boots, Shoes, and Gloves, *J. Abrahamson, London.—10th May,* 1881.—*(Provisional protection not allowed.)* 2*d.*
This relates to the use of a revolving button.

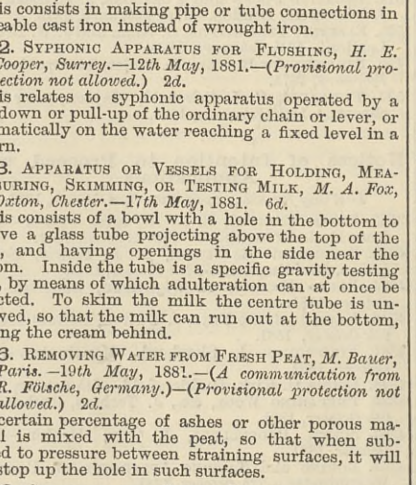
2052. Making Pipe or Tube Connections, &c., in Malleable Cast Iron, *H. F. Baker, Smethwick.—11th May,* 1881.—*(Provisional protection not allowed.)* 2*d.*
This consists in making pipe or tube connections in malleable cast iron instead of wrought iron.

2082. Syphonic Apparatus for Flushing, *H. E. Cooper, Surrey.—12th May,* 1881.—*(Provisional protection not allowed.)* 2*d.*
This relates to syphonic apparatus operated by a pull-down or pull-up of the ordinary chain or lever, or automatically on the water reaching a fixed level in a cistern.

2158. Apparatus or Vessels for Holding, Measuring, Skimming, or Testing Milk, *M. A. Fox, Oxton, Chester.—17th May,* 1881. 6*d.*
This consists of a bowl with a hole in the bottom to receive a glass tube projecting above the top of the bowl, and having openings in the side near the bottom. Inside the tube is a specific gravity testing float, by means of which adulteration can at once be detected. To skim the milk the centre tube is unscrewed, so that the milk can run out at the bottom, leaving the cream behind.

2186. Removing Water from Fresh Peat, *M. Bauer, Paris.—19th May,* 1881.—*(A communication from R. Fölsche, Germany.)—(Provisional protection not allowed.)* 2*d.*
A certain percentage of ashes or other porous material is mixed with the peat, so that when subjected to pressure between straining surfaces, it will not stop up the hole in such surfaces.

2278. Couplings for Screw Propellers, &c., *A. Ferity, Bramley.—24th May,* 1881. 6*d.*
The two end pieces *c* and *d* of the shafts *e* and are recessed or cupped to receive a ball *i* inserted between them. This ball *i* retains the axes of the



ends of each shaft equal distances from its centre without retarding or interfering with the motion thereof. In order to retain the ends *c* and *d* of the shafts *e f* in contact with the ball *i*, at the same time to allow any excentric or irregular movement thereof, bossed discs or coupling plates A and B are fitted, corresponding with each other on their respective shaft ends; these discs or plates A and B have suitable projecting pieces or lugs *j* and *k*, which are brought or geared together.

2228. Harbour and Dock Works, *St. J. V. Day, Glasgow.—21st May,* 1881.—*(A communication from W. R. Kinipple, Ottawa, Canada.)—(Provisional protection not allowed.)* 2*d.*
The foundations of the submerged portions of harbour and dock works is formed of concrete placed in the water in a plastic instead of in a liquid condition.

2238. Respirators, *I. A. Best, Birmingham.—23rd May,* 1881.—*(Provisional protection not allowed.)* 2*d.*
This consists in raising respirators in moulds or dies, in metal, horn, vulcanite, or other material, and also in the form and shape of same.

2496. Preparation of Edible Oils and Fats, *A. Fenwick, Hampstead.—8th June,* 1881.—*(Provisional protection not allowed.)* 2*d.*
Flour is mixed with water and baked, and then reduced to a granular condition, after which any edible oil, such as cotton-seed oil, is applied to the granules, and when thoroughly absorbed, a substance having the appearance of moist sugar is produced, which after a dressing of rice flour to keep the granules apart may be used in a variety of ways for culinary purposes.

2664. Compressed Food for Cattle, *W. Jamaiker, Berlin.—18th June,* 1881.—*(Provisional protection not allowed.)* 2*d.*
Agricultural produce, and waste matter from agricultural manufacture, such as bran, fodder meals, malt germs, beer malt dust, the resdiuums from oil manufacteries and beetroot sugar refineries are mixed together so that the proportion of the proteine con-contents to the hydrate of carbon contents in the mixture shall be as 1 to 3-4. The proportion of dry substance is from 40 to 50 per cent. of the mass. Salt and salicine acid are then added and the whole crushed and left to ferment, after which they are worked into a dough and moulded and dried.

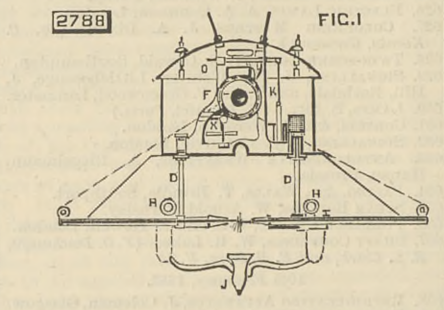
2702. Envelopes, *J. Heu, Paris.—20th June,* 1881.—*(Provisional protection not allowed.)* 2*d.*
The object is to prevent envelopes being opened without leaving traces of such opening, and it consists in forming the flap of a lace pattern stamped out so as to tear easily.

2712. Transmitting Secret Correspondence by Telegraph, &c., *D. Nicoll, Westminster.—21st June,* 1881.—*(Provisional protection not allowed.)* 2*d.*
This relates to the use of a set of plates with blank spaces to be placed consecutively over the telegraph form, so as either to fill in or read the message.

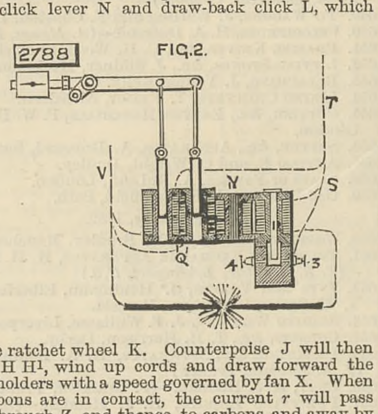
2744. Metal Cans, *C. Laurent and H. W. Brand, Middlesex.—23rd June,* 1881. 6*d.*
The top edge of the body of the can is swayed inwards, and the cover is formed with a V groove projecting from its underside, and at such distance from the edge as to lie upon the face of the swaged edge of the can, while a margin is left on top wide enough to form a groove when in place to receive the solder. The cover is formed with a flap, the end of which can be grasped by a split key, and upon turning the key the cover will be rolled off when required to open the can.

2777. Signalling on Railways, *G. Brocklebank, Anerley, Surrey.—25th June,* 1881. 6*d.*
The object is to provide sound as well as visible signals, and it consists in fixing a frame upon one side of the engine, in which a wheel is mounted on a lever, and is actuated by a board fixed alongside of the track. The lever is connected to a gong, bell, or whistle on the engine.

2788. Improvements in Means or Apparatus Employed in Obtaining Light by Electricity, *B. J. B. Mills.—25th June,* 1881.—*(A communication from F. Million, Lyons.)* 6*d.*
This invention relates to means whereby a steady light for a long period is produced, and by which several lamps can be employed in one circuit in such a way that should one or more go out, the rest will not be affected. Fig. 1 gives a general view of the lamp, and Fig. 2 a detailed view of the various parts

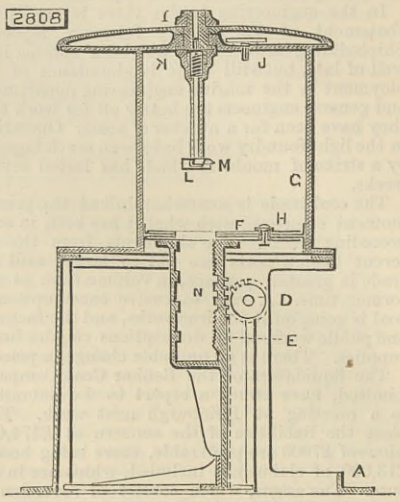


relating to the regulation and automatic derivation of the current in case of accident. The carbons are advanced towards each other or withdrawn by means of the pulleys and ropes, connected with the two counterpoises O and J as shown. The current is conveyed to the carbons through the two columns D D^1, and platinised contact pieces bearing on the carbons at the extreme inner end of the holders. Supposing the carbons to be separated, a current coming by *r* will pass by *s* to contacts 3 and 4, through the mercury of solenoid Z, then through Y and Q^1 to *v*. In traversing Q^1 it will cause P^1 to be attracted, and consequently all the current will pass through Q^1. P^1 will operate click lever N and draw-back click L, which



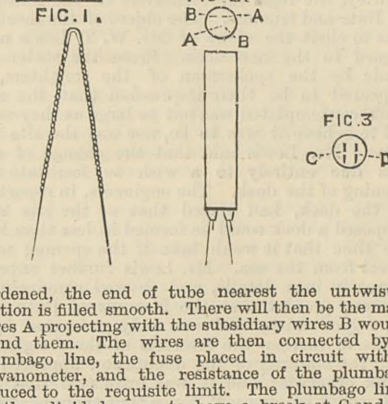
will free ratchet wheel K. Counterpoise J will then operate H H^1, wind up cords and draw forward the carbon holders with a speed governed by fan X. When the carbons are in contact, the current *r* will pass partly through Z, and thence to carbons and away by *ι*. But in traversing Z it will raise bar 1 to position shown in Fig. 2. The mercury will fall to its own level; contacts 3 and 4 will be isolated, and all the current will pass through carbons in contact. Q^1 will cease to attract P^1; counterpoise G will cause click lever to return; L will again fall on ratchet wheel which will be pushed forward, wind up the cords on T, and drawing back the carbons, establish the arc.

2808. Signalling by Sound in Fogs for Sea and River Navigation, *J. G. Jebb, London.—27th June,* 1881.—*(A communication from W. B. Barker, Hoboken, New Jersey, U.S.)* 6*d.*
A is the base plate of the machine; D driving pinion; E driving rack; this rack is attached and moves with the piston head F of the cylinder G or air compressor. The air compressor receives its air by the valve H, discharging it by the aperture I, which communicates with the fog horn or other sounding instrument. J is the safety valve to prevent undue pressure; K is the valve opening to the fog horn kept



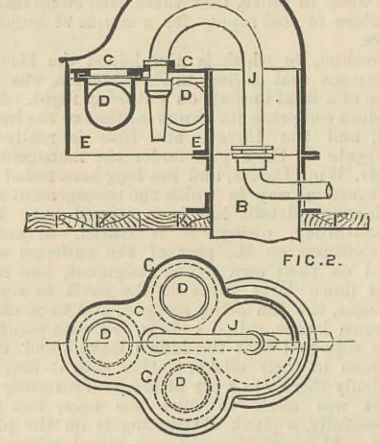
closed by the helical spring shown in the drawing, and pulled open by the wire leading from the valve spindle of K to the bell-crank L by the action of the lever M as it is acted on by the face of the code to be used at N.

2826. Improvements in Electric Fuses, *D. Johnson, Chester, and E. Spon, London.—28th June,* 1881. 6*d.*
This consists in multiplying the points at which an electric spark may occur. Two wires are twisted together as shown in Fig. 1, with a portion left untwisted, say about half an inch. They are then inserted in a paper or other tube, Fig. 2, and the latter is filled with an insulating material. When this is



hardened, the end of tube nearest the untwisted portion is filled smooth. There will then be the main wires A projecting with the subsidiary wires B wound round them. The wires are then connected by a plumbago line, the fuse placed in circuit with a galvanometer, and the resistance of the plumbago reduced to the requisite limit. The plumbago lines are then divided so as to have a break at C and D, Fig. 3. Finally the fuse is inserted into a fuse containing the fuse composition.

2828. Ventilating Steamships and Sailing Vessels, *J. Colling, Sunderland.—28th June,* 1881. 6*d.*
Fig. 1 shows a sectional elevation, and Fig. 2 a plan—half in section—of one of the improved outlet or upcast ventilators fitted with a steam jet J. The cowl A is in this case a casting revolving on a socket



and flange joint upon the part B, which is fixed to the deck, and containing the valve seats C, in which are fitted three spherical or ball valves D, formed of some suitable material, preferably made hollow for lightness, and confined in cages E. The normal position of these valves is at the bottom of the cages, the apertures being then open, but when a wave is shipped tending to rush into the open mouth of the ventilator, the balls float upwards upon it, and close the apertures till the wave has passed, when they reopen by falling into their cages.

2834. Reverberatory Furnaces, *G. Fenwick, Gateshead, and B. Cochrane, Durham.—28th June,* 1881. 6*d.*
The object is to utilise the heat in the most advantageous manner, so as to effect an economy of fuel, and it consists in forming a chamber or chambers over the top of furnace, communicating at the rear end with the body of the furnace by small regulated openings, and terminating at the front end in a closed ashpit. The chambers are provided with a series of baffles placed at an angle, and so arranged that whilst they admit a portion of the flame to pass freely along the chamber to the ashpit, and thence by passing over and through the fire-bars to intensify the heat, they will at the same time form an obstruction to the return of any gaseous products under the draft of the chimney.

2844. Checking and Recording the Use of Stamps, *F. S. Willoughby, Lancaster.—29th June,* 1881.—*(Provisional protection not allowed.)* 2*d.*
The object is to check the stamps used in an office, and consists in fixing them to a tablet divided into squares, so that as each stamp is removed the person doing so can mark the square under it with his initials and the purpose for which it was taken.

2845. Apparatus for Heating and Boiling Water, *T. Drake, Huddersfield.—29th June,* 1881. 6*d.*
The apparatus consists of an outer casing or shell, within which are placed two pipes or tubes C and D, having their upper ends closed and their lower ends open. Passing horizontally through these tubes towards their bottom ends is a gas pipe F, having a burner G branching therefrom about the centre of each tube. The burner has a solid concave cap, which

projects slightly, so as to form a rim, and a series of holes are made in the burner at an angle of 45 deg., so that the gas as it escapes from the perforations in the side of the burner is thrown up against the inner sides of the two pipes at the said angle of 45 deg. Around each of the vertical tubes is a coil of metal piping I, connected together and communicating with a third

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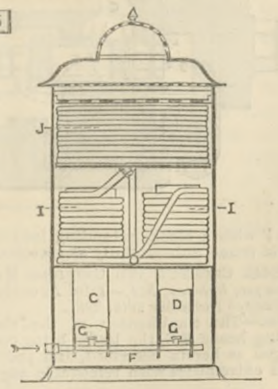

coil J of larger dimensions, placed in the upper portion of the casing. The water in the coiled pipes is heated by means of jets of gas, which issue from a series of holes formed spirally around the two upright tubes.

2855. TENONING AND SHOULDERING MACHINE, *G. H. Couch, Croydon.—30th June*, 1881. 6d.

A is the frame secured to a foundation plate; C is the main shaft mounted in bearings in hanging

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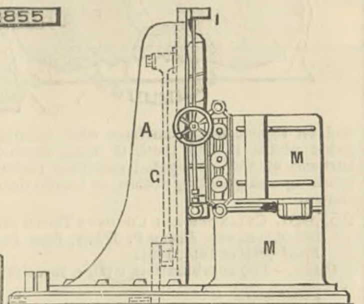

brackets D, fixed to underside of foundation plate. On the main shaft is a disc H connected by rod G to the slide I carrying planes and saws. M is a stationary fence to which the wood to be operated upon is clamped.

2860. PRODUCTION OF SOUND INGOTS AND CASTINGS OF STEEL, &c., *A. Longsdon, London.—30th June, 1881.—(A communication from F. A. Krupp, Essen, Germany.)* 6d.

The drawing shows a mode for casting from below. The metal is run into the mould D from the conduit G; G^1 is a nut formed in a crosshead, which by means of two rods is so connected to the bed-plate S that it can be swung out of the way of the conduit inlet funnel when the metal is poured in by the said inlet funnel; G^2 is a screw working in the nut G^1 and

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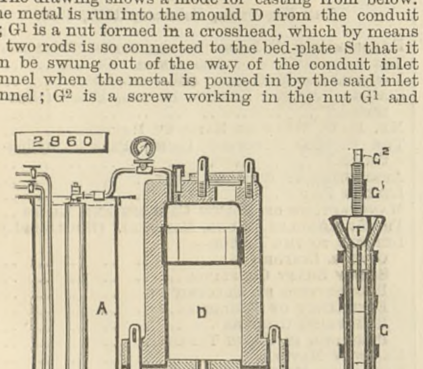

furnished with a crutch handle, so that the screw can be forced down upon the cone plug T to close the inlet funnel securely against the high internal gas pressure. A is a very strong metallic reservoir or flask containing the carbonic acid or other substance, which is to supply the required very high gas pressure to the molten metal in the mould.

2866. LOOMS, *F. O. Tucker, Hartford, U.S.—1st July, 1881.* 6d.

This relates to apparatus for stopping the loom when the weft is absent, and consists in using the weft fork or needles and upright rod referred to in patent No. 4592, A.D. 1880. In the drawings 1 is the slay

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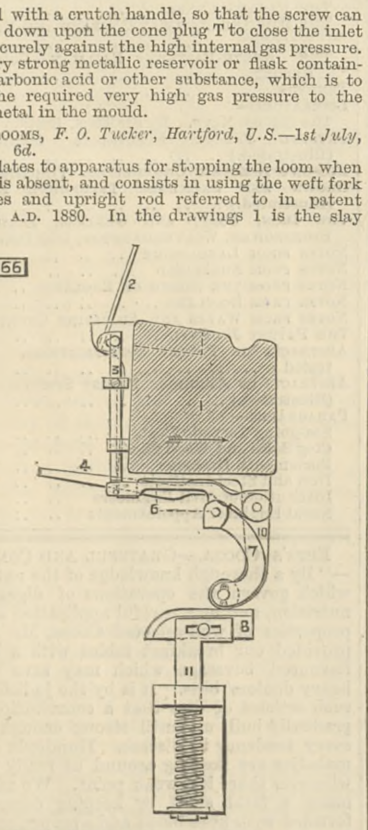

board; 2, the weft fork or needles; 3, the upright rod; and 4, a dagger hinged on a stud. The weft fork and the rod are raised by lever 6, which at each backward movement of the slay is itself raised by the arm 7 riding upon the spring cam for incline 8. The arm 7 is hinged to lever 6, so as to open in one direction only. As the joint or hinge opens the lever 6 is lowered, and allows the rod and needles to be lowered on to the weft; but if there is no weft the needle drops into a groove cut in the slay and stops the loom. The dagger 4 has an arm 10, and is raised at each backward stroke by an incline 8 adjustable in slotted rods 11.

2859. MANUFACTURE AND TREATMENT OF GAS, &c., *J. E. Dowson, Westminster.—30th June, 1881.* 6d.

The invention consists of a tubular boiler formed by one or more lengths of piping, bent so as to form a series of horizontal rows, one over the other, each succeeding row crossing the one preceding it at right angles. Water is caused to flow through the coil, and is heated by a gas burner or furnace, the steam being conducted to a gas generator or retort, where it is decomposed. A special form of jet is used to introduce the steam to the gas generator or retort.

2867. IMPROVEMENTS IN TELEPHONIC APPARATUS, *W. E. Potter, Liverpool.—1st July, 1881.* 6d.

The object of this invention is to obviate the necessity for replacing the telephone on a hook when a message has been received, in order to be in a position to receive a call, and also to be at liberty to use both hands to write with, instead of having to hold the

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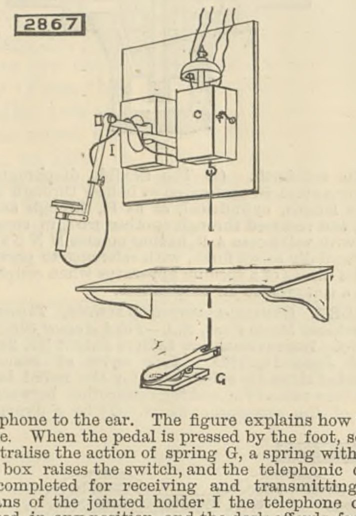


telephone to the ear. The figure explains how this is done. When the pedal is pressed by the foot, so as to neutralise the action of spring G, a spring within the call box raises the switch, and the telephonic circuit is completed for receiving and transmitting. By means of the jointed holder I the telephone can be placed in any position, and the desk affords facilities for writing.

2868. PRINTERS' INK, &c., *P. Jensen, London.—1st July, 1881.—(A communication from H. Günther, Berlin.)—(Void.)* 2d.

This relates to the production of a black printers' ink from pitch or asphalte, anthracene oil, or the heaviest or least easily boiling parts of tar oil, an aniline colour soluble in alcohol, a lubricating soap, which can best be made of train oil, and the best never-drying Greenland train oil.

2869. GAS LAMPS OR LANTERNS, *F. W. Clark, Westminster.—1st July, 1881.* 6d.

This relates to lamps in which heated air is supplied to the flame so as to effect a more perfect combustion, and it consists in forming the lamp body of a case, to which two concentric tubes with a space between them are adapted, the inner one serving to carry off the products of combustion, and extending above and below the outer one, which serves to admit air to a chamber formed by the body of the lamp and the tubes. The air in its passage through the tubes is heated, and is conveyed by a pipe to the gas-burner or flame, to which the gas is supplied by a pipe coiled between the concentric tubes, so that the gas also is heated on its passage to the burner.

2878. WAGON AXLES, *S. Bradley, Worcester.—1st July, 1881.* 4d.

A stump or projecting arm of a crank form is applied to the cap of the axle, so as to act as a step plate.

2882. PREPARING VEGETABLE SUBSTANCES FOR BREWING AND DISTILLING, &c., *R. G. Perry, Queen's County.—2nd July, 1881.* 4d.

The vegetable substance is crushed or sliced and placed in an exhausted receiver, and all the latent air withdrawn from it by an air pump. It is then covered in vacuo with a solution of some alkaline carbonate at a temperature a little above zero. After about fifteen minutes the alkaline solution is withdrawn and replaced by an acidulated solution of equal strength, whereby a brisk effervescence is produced, and the carbonic acid gas generated in its efforts to escape disintegrates the minutest cells and fibres, and develops fully the special qualities of the material.

2890. BLEACHING ANIMAL AND VEGETABLE FIBRES, *W. A. Barlow, London.—2nd July, 1881.—(A communication from L. Naudin and J. Schneider, Paris.)* 6d.

The electrodes of any electrical source are placed in a trough or tub containing the fibres to be bleached, and a solution of a compound body which will serve to liberate an oxidising agent in the nascent state by electrolysis, as chlorine, oxygen, &c.

2892. SCRIBBLING AND CARDING MACHINERY, *A. Barker, Leeds.—2nd July, 1881.* 4d.

The object is to separate the slivers as they are taken off the condenser doffer, and to prevent them coming together again as they are being conducted forward to the rubber sheets, and it consists in providing flanges or discs on the stripper corresponding with the spaces between the card rings on the doffer, and projected such a distance from the stripper as to work or run within such spaces, and they separate the slivers so completely and retain such separation that they cannot come together again.

2897. SAFETY FASTENING FOR BRACELETS, &c., *A. E. Parkes and F. Westwood, Birmingham.—2nd July, 1881.* 6d.

Each end of the bracelet is angular, and has a slot cross-wise, and one end is fitted with two levers projecting at either side of the bracelet, and carrying hooks which project from the slot. The two levers are forced outwards by a spring between them, and their hooks engage the slot in the other end. To disengage the hooks the ends of the levers are pressed inwards.

2898. EXTINGUISHING FIRES, &c., *F. Grinnell, Rhode Island, U.S.—2nd July, 1881.* 6d.

This relates to apparatus for extinguishing fires automatically and for operating an alarm, and it consists of a system of pipes containing water or other extinguishing agent, and provided with valves which are opened by the action of heat, and a system of wires united at intervals by a metal fusible at a low temperature, so as to make a closed electric circuit, which when broken releases a suitable apparatus by which an alarm is sounded, and the supply of water or other extinguishing agent is turned on.

2900. CASES FOR PACKING EGGS, &c., *W. J. Young, Bristol.—2nd July, 1881.* 6d.

A series of rows of cells or separate compartments are formed one over the other by strips of cardboard or wood, each to contain one egg or other article, and the whole placed in a case with a lid secured by a lock.

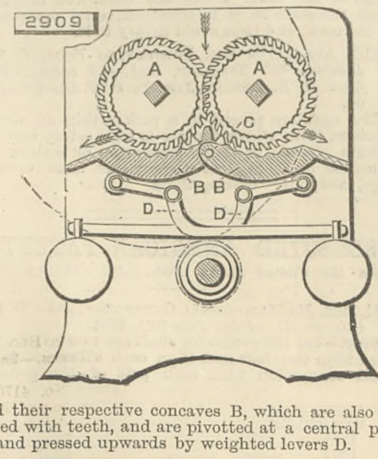
2902. MOVABLE HORSESHOE, *J. Balbi, Paris.—4th July, 1881.—(Not proceeded with.)* 2d.

The sole of the hoof rests on the iron of the shoe, which on its underside has a number of spikes to prevent slipping. The iron rises round the hoof in a rim which holds the toe and sides of the hoof, while the frog separating the heel rests on a part of the shoe which is bent inwards. At the rear the rim is higher to receive a fastening piece which slides in slots in the ends of the bent-up rim.

2909. CRUSHING AND GRINDING MILLS, *W. N. Nicholson, and W. Mather, Newark-upon-Trent.—4th July, 1881.* 6d.

The substance to be crushed enters between the toothed rollers A which are geared together, and being thereby partially crushed passes between the rollers

2909



and their respective concaves B, which are also provided with teeth, and are pivotted at a central point C, and pressed upwards by weighted levers D.

2910. CLIPPERS FOR HAIR, &c., *J. Trickett, Newark-upon-Trent.—4th July, 1881.* 6d.

A handle is rigidly attached to a metal cover plate, on the underside of which are four studs taking into holes formed in the bottom fixed cutter, and serving as distance pieces between the two plates, while the movable reciprocating cutter which works between them has slots to allow the front studs to pass and act as guides. A central bolt secures the cover plate and the bottom fixed cutter together, while the movable cutter has a slot through which the bolt passes.

2913. ORNAMENTAL GLASS, *T. D. McD. Farrall, Bermondsey.—4th July, 1881.—(Not proceeded with.)* 2d.

This relates to the production of new and special ornamental effects in all kinds of glass ware, and it consists in applying to the semi-fused surface of the glass mixtures of crystals of the metallic nitrates and chlorides, then subjecting the mass of glass with the adhering crystals to the action of carbonic acid gas, and finally in blowing or moulding the glass and crystals to the desired form.

2922. COMBINATION FURNITURE, *L. Bonduel, Paris.—4th July, 1881.—(Not proceeded with.)* 2d.

This consists in the combination in one piece of furniture of a cupboard, looking-glass, washing-stand, water-closet, and bath.

2925. COMPOSITION OF MATTER FOR PREVENTING AND REMOVING INCRUSTATIONS IN BOILERS, *H. A. Bonneville, Paris.—5th July, 1881.—(A communication from Commander P. Alfieri, Naples.)* 2d.

250 grammes carbonate of baryta, 325 grammes nitrate of ammonia, 225 grammes chloride of soda, and 200 grammes of vegetable charcoal, are reduced to powder, and when mixed are put into the boiler with the water, in which they dissolve and prevent or remove incrustations.

2944. IMPROVEMENTS IN THE MANUFACTURE OF ELECTRIC TELEGRAPH WIRE ROPES OR CABLES, *J. P. Hooper, London.—5th July, 1881.* 6d.

The object of this invention is to avoid springiness in paying out, and the consequent formation of kinks. To do this the inventor uses strands having a right-hand and left-hand way alternately for the outer covering of the cable.

2952. PREPARING TEXTILE MATERIALS WITH CHEMICAL SOLUTIONS OF SILK, WOOL, OR FEATHERDOWN, OR MIXTURES THEREOF, *L. A. Groth, London.—6th July, 1881.—(A communication from H. R. P. Hosemann, Berlin.)* 4d.

This relates to the treatment of textile fibres of all kinds and forms in cold, warm, or hot, and more or less diluted alkaline solutions of silk, wool, or featherdown, or mixtures thereof, without the employment of pressure, electricity, &c , whereby the silk, wool, or featherdown forming the principal ingredient or ingredients of such solutions is or are precipitated upon the said textile fibres so as to cover them therewith in such a manner that the covered textile fibres can be subsequently dyed, bleached, and finished.

2966. GRAIN-BINDING MACHINES, *G. E. Vaughan, London.—7th July, 1881.—(A communication from M. A. Keller, Brockport, New York, U.S.—(Complete.)* 10d.

This relates to certain improvements in automatic grain binders for packing the grain as it comes from the gleaner or elevator into bundles, and in means for compressing the bundles for the purpose of binding the same; in mechanism for automatically locking and unlocking the compressor; it further relates to mechanism for discharging the bound bundles from the machine, also in mechanism for uniting the ends of the applied band, and means for holding and cutting the binding cord, and in the general and particular construction and operation of the parts and combination of parts.

2967. GAS ENGINES, *E. J. Wastfield, Bath.—7th July, 1881.—(Not proceeded with.)* 2d.

An inverted cylinder is preferably used; the piston is a long one, something like that of an ordinary trunk engine, but it is also prolonged upon its inner side in a similar way, or the inner prolongation alone may be used if preferred, the recess thus formed giving room for the charge without the necessity of using a very long cylinder, as is now commonly done. In or beside the cylinder, for instance in the bed-plate when convenient, is formed a cavity, which acts in a somewhat similar manner to that of the air vessel of a pump, the object being to allow the air which it contains to be compressed by the explosion.

2972. LOOMS, *W. Atherton, Preston.*—7th July, 1881. 4d.

This refers to the mode of securing the outer roughened or perforated metal covering to the taking-up beams in looms, and it consists in fitting a bar of wood within the sheet metal tube, so that the outer perforated covering may be attached to the roller by means of nails driven through the sheet metal into the two outer edges of the bar.

3001. ANCHORS, *H. Terrell, Regent's Park.—8th July, 1881.—(A communication from S. St. O. Chapleau, New York, U.S., and A. L. Smith, Montreal, Canada.)* 6d.

This relates to improvements on patent No. 1632, A.D. 1872, and it consists in forming two shoulders on the fluke arms to work within recesses at the sides of the head of the shank. The arms are maintained in position by a plate inserted either from the side or through an aperture in the top of the head of the shank into a space within the same, such space being so situated that when the plate is inserted it will be between the shoulders on the fluke arms, the plate being secured in position by pins.

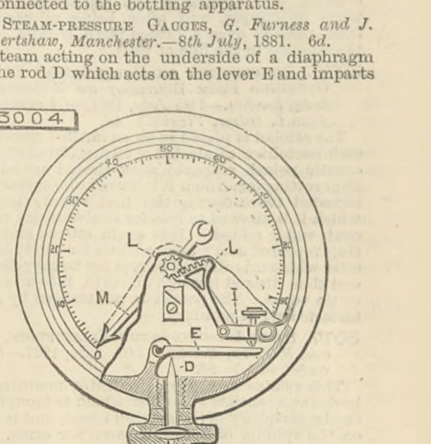
3006. CONDENSING PUMPS AND CYLINDERS FOR MANUFACTURE OF AERATED WATERS, *J. McEwen and S. Spencer, Manchester.—18th July, 1881.* 6d.

The crank shaft is mounted in a frame and carries fast and loose pulleys at one end and a fly-wheel at the other. Above it are mounted the pump cylinders lined with glass tubes and swung upon hollow trunnions above, so that they can oscillate, the piston-rods working direct upon the crank pins. In connection with the inner ends of the trunnions are fixed junction pipes with valves, and having their lower ends in connection with the vessel containing the water and gas, and at their upper ends with the top of the condensing cylinder. The latter has a dome-shaped top, and at its apex is a chamber with perforated top and bottom, and filled with "glass wool." Within the outer dome is a second dome, the space between them being also filled with glass wool. Hollows are left to allow the water and gas to pass from the outer to the inner dome, and in the centre of the bottom plate is a glass tube extending to near the top, and its lower end being connected to the bottling apparatus.

3004. STEAM-PRESSURE GAUGES, *G. Furness and J. Robertshaw, Manchester.—8th July, 1881.* 6d.

The steam acting on the underside of a diaphragm raises the rod D which acts on the lever E and imparts

3004



motion to the forked lever arm I, whereby the quadrant J gearing with pinion L causes the hand M to move over the dial.

3017. HORSE COLLARS, *H. J. Haddan, Westminster.—9th July, 1881.—(A communication from O. Duplant, Bailleau le Pin, France.)—(Not proceeded with.)* 2d.

This consists in making the side frames adjustable to fit any horse.

3026. BRUSHING, CLEANING, AND POLISHING LEATHER, *P. Newall and J. Barker, Warrington.—9th July, 1881.—(Not proceeded with.)* 2d.

A cylindrical brush is caused to revolve, and a table capable of rising and falling receives the leather, and is pressed upwards by weights, so as to maintain the leather in contact with the brush.

3029. FORMING AND BINDING CUT CROPS INTO SHEAVES, *G. Spencer, Wirksworth, Derby.—9th July, 1881.—(Not proceeded with.)* 4d.

According to a previous patent the ends of a cord are secured after being passed round the sheaf by first twisting the ends together, then causing them to lie in opposite directions alongside the cord round the sheaf, and then by a pair of rubbers causing the cord to roll over and wind by the ends around itself. The twisting of the two ends is effected by a disc caused to revolve, and having a portion of its circumference notched out.

3033. LIFE-PRESERVING CORSETS, *A. C. Henderson, London.—11th July, 1881.—(A communication from D. F. Trefcon, Paris.)—(Not proceeded with.)* 2d.

This consists of a corset made up of strips of cork secured between two waterproof cloths, and articulated so as to make them flexible and fit to the body.

3035. METALLIC FABRIC, *G. W. von Nawrocki, Berlin.—11th July, 1881.—(A communication from Messrs. Schütz and Juel, Wurzen, Germany.)* 2d.

The metal is reduced to small particles and mixed with a sticky material, the mixture being placed on the back of a fabric, which is then dried and calendered.

3047. MOUNTING BOOTS AND SHOES WITH ICE-SPURS, *L. Bensel, Germany.—12th July, 1881.—(Not proceeded with.)* 2d.

A plate is secured to the front of the heel, and is pivotted, so that when turned down it brings the ice spurs under the heel, whilst when turned up the spurs are out of the way.

3060. TRUEING UP AND FINISHING ROUND BARS, RODS, OR TUBES, *W. H. Brown, Sheffield.—13th July, 1881.—(Not proceeded with.)* 2d.

This consists chiefly in a combination of the processes known as reeling, and rolling, and operating on the bar, rod, or tube at one and the same time.

3062. TREATING WOOD FOR PAPER-MAKING, &c., *C. D. Ekman, Sweden.—13th July, 1881.* 4d.

This consists, First, in the boiling of wood under pressure with a solution containing sulphurous acid and magnesia; and Secondly, in the use of a valve for blowing off gas and steam during the operation.

3063. MANUFACTURE OF YEAST AND VINEGAR, *J. Jensen, Newcastle-on-Tyne.—13th July, 1881.—(A communication from N. Rasmussen, Copenhagen.* 4d.

Cereals, which when treated by this process will yield saccharine matters, are steeped in water, crushed, and put into the mashing vat, where about half a pint of water is added to each pound of cereal, and the whole heated to 142 deg. Fah. for two hours. Over the vat is a perforated tube, which revolves slowly, and supplies water at 153 deg. Fah. to the mash. The liquor is run into a second vat until the saccharometer indicates zero, when it is stopped, and any liquid remaining in the first vat can be added to the next mash. The liquor is now conducted from the second to the yeast vat, which is provided with means to cause air to pass through the liquor, and with a cooler. Two pounds of pure fresh "mother yeast" is added to the liquor for every hundredweight of grain used, and the air machine is set to work to bring the liquor to 86 deg. Fah., when it is pumped back to the second vat and allowed to settle, the yeast falling to the bottom, and the liquor being drawn off and used to manufacture vinegar.

3070. BOOTS AND SHOES, *J. Robertson, Kilburn.—14th July, 1881.—(Not proceeded with.)* 2d.

A piece of elastic webbing is inserted into the upper of the boot or shoe over the instep, and a leather flap is buttoned over it, the button-holes being long enough to allow of a certain amount of play.

3071. AUTOMATIC SELF-CLAMP GUILLOTINE PAPER-CUTTING MACHINES, *H. P. Trueman, Birmingham.—14th July, 1881.—(Not proceeded with.)* 2d.

The improvements consist, First, of an automatic arrangement to stop the knife when it reaches the end of the return stroke, and is not commenced until the attendant again puts the knife into gear with the driving wheel; Secondly, in the use of a clutch lever connected with a clutch; Thirdly, in means by which the fence can be adjusted to work perfectly parallel to the knife; Fourthly, in an automatic clamp by which, when the machine is put into gear with the driving wheel, the press-plate is at once forced down on to the paper before the knife reaches it.

3072. COMPOSITION CONTAINING PYROXILINE OR NITRO-CELLULOSE, *C. F. Claus, London.—14th July, 1881.* 4d.

This consists in the manufacture of improved compositions by the admixture of the oxychloride of zinc of magnesia, or of lead or a mixture of the same, with pyroxiline or nitro-cellulose.

3073. IMPROVEMENTS IN LAMP CASINGS OR HOLDERS FOR CONTAINING AND PROTECTING ELECTRIC LIGHTS, &c., *D. Graham, jun., Glasgow.—14th July, 1881.—(Not proceeded with.)* 2d.

This relates to an improved kind of lanthorn for holding incandescent and arc lamps, and to a means for fixing the lamps in the lanthorn. Also to an improved contact piece in which water and mercury are contained, the water being designed to prevent the spark occasioned by contact being made from setting fire to any gases, &c., that may be near.

3075. Locking and Unlocking Railway Signal and Point Levers, *M. C. and T. J. Denne, Eastbourne.—14th July, 1881.—(Not proceeded with.)* 2d.

This relates to improvements on patent No. 5404, A.D. 1880, and consists of an appliance to be attached to signal and point levers to relock them without altering the position of the signals and the levers when at danger, and after being released by the train passing over a bridge piece, treadle, or camber placed close to the line of rails.

3076. Disinfection or Purification of Alcohol Obtained from Beetroot or Molasses, *W. R. Lake, London.—14th July, 1881.—(A communication from L. Salzer, Vienna.)* 4d.

The alcohol is placed in an enamelled vessel, and for each hectolitre of alcohol of 90 deg., 70 or 80 grains of caustic potash prepared with alcohol are added, and after resting for an hour it is stirred, the operation being repeated twice during the first twenty hours, after which it is allowed to rest for twelve hours and 10 per cent. water added. It is again stirred and the stirring repeated every twelve hours for thirty-six hours, after which it is allowed to rest for twenty-four hours, and then filtered through amianth into an enamelled or tin vessel. The potash is neutralised by means of tartaric acid in powder.

3077. Speed Indicators for Velocipedes, *H. S. H. and E. Shaw, Bristol.—14th July, 1881.—(Not proceeded with.)* 2d.

This relates to a speed indicator mounted on the brake, and consists of a roller which is brought to bear on the periphery of the driving wheel, and is mounted on the spindle of a pair of governor arms, through which motion is imparted to a pointer moving over a suitably divided dial.

3084. Snap or Fastening for Purses, Bags, &c., *R. J. S. Joyce, London.—14th July, 1881.—(Not proceeded with.)* 2d.

This consists of two sliding plates pressed towards each other by springs, and between which a stud on the other part of the article is forced.

3085. Alarms for Road Vehicles, *R. Roger, Stockton-on-Tees.—14th July, 1881.—(Not proceeded with.)* 2d.

This relates to a whistle capable of being sounded by a current of air supplied by a small pump, driven by the wheels of the vehicle.

3087. Metallic Tubes and Rods, *J. V. Jones, Saltley, near Birmingham.—14th July, 1881.—(Not proceeded with.)* 2d.

This relates to means for producing tubes or rods with a smooth exterior so as to do away with the smoothing and polishing processes, and it consists in causing the tube or rod as it leaves the draw plate to pass through a chuck or collar, the inner surface of which is made similar to a file.

3088. Manufacture of Steel from the Residuum of Pyrite Roasting Furnaces or from Iron Ore, *W. T. Whiteman, London.—14th July, 1881.—(A communication from C. Martin, Belgium.)—(Not proceeded with.)* 2d.

The residuum is reduced to powder and placed upon sheet iron plates perforated with holes of about $\frac{1}{8}$ of an inch in diameter, and is washed in a vessel mounted upon fixed or shaking tables so as to enrich it by depriving it of its earthy parts. The residuum is then mixed with coal or other carbonaceous matter, and unctuous clay and lime or other material capable of forming a very fusible flux is added. The mixture is moistened with water rendered alkaline or acid, and formed into blocks by hydraulic pressure, and subjected to heat in a furnace.

3096. Ornamenting or Decorating the Covers of Books, Cigar Cases, &c., *L. Dee, Middlesex.—15th July, 1881.—(Not proceeded with.)* 2d.

This relates to the production of patterns in relief on the covers of books, &c., by means of suitable pattern plates

3097. Sorting, Beating, and Breaking the Waste of Wool, Cotton, &c., *E. de Pass, London.—15th July, 1881.—(A communication from Messrs. H. Blank and Garnier, Aix-la-Chapelle, Germany.)—(Not proceeded with.)* 2d.

This consists of a slowly revolving cylinder sieve armed on its inner periphery with points, spikes or pins. Within this cylinder are arranged beaters mounted spirally on a quickly rotating spindle.

3098. Pencil-case or Holder, *S. Guiterman, London.—15th July, 1881.—(A communication from L. L. Tower, New York, U.S.)—(Not proceeded with.)* 2d.

This relates to pencils in which the lead is gripped by jaws compressed together by an outer sheath, and it consists in fixing or releasing the jaws by making the sheath slide in or upon a tubular extension of the stem of the handle.

3780. Selecting Devices for Controlling Type-setting Machines, *J. E. Munsen, New York, U.S.—30th August, 1881.—(Complete.)* 6d.

Movable perforated plates similar to the "jacquard" mechanism of looms are employed in combination with pins, and are operated by keys.

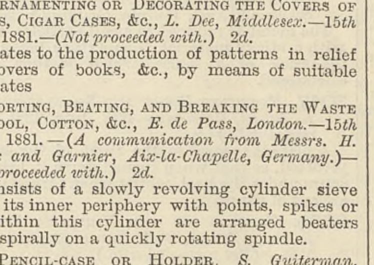
4023. Stitching Lapped and Butted Seams, &c., *R. H. Brandon, Paris.—19th September, 1881.—(A communication from the Morley Sewing Machine Co., Holyoke, Mass., U.S.)—(Complete.)* 6d.

This relates to a method of sewing in lap-seam work by carrying double-threaded stitches across the edge of the overlapped piece of fabric, and in sewing butted seam stitches carrying said double-thread stitches across the meeting edges of the fabric, and in sewing on shank buttons, causing said double-threaded, diagonal, or cross stitches to be made through the shank of a button which has been placed in proper position therefor upon the fabric.

4211. Cartridge Feeder for Machine Guns, *R. H. Brandon, Paris.—29th September, 1881.—(A communication from the Gatling Gun Company, Hartford, U.S.)—(Complete.)* 6d.

The hopper D is placed on the machine gun H, of which X is the carrier wheel, C is the foot of the feeder, from which an arm E hangs down, and through it passes a screw having a shoe hung on its end under

4211



arm E. I I are vertical supports on foot C, between which a roller stop O slides vertically; N is a fluted cartridge straightening roller, supported on bearings between supports I, and one side of which projects through the foot and into the passage therein, through which the cartridges pass from conductor A on their way to the carrier wheel X.

4170. Corking Machines, *C. Farrow, London.—27th September, 1881.* 6d.

The object is to prevent injury to the cork during compression, and it consists in providing the tube with a hinged joint at its smaller end, so as to allow the tube to be opened to receive the cork. The movement of the lever closes the tube, and moves forward the slide so as to effect an equal compression of the cork, and thus avoid injury to it.

4910. Apparatus for Preserving Eggs, *T. Stead, London.—9th November, 1881.—(A communication from H. H. Loomis, New York, U.S.)—(Complete.)* 6d.

The eggs are placed in a rack within an air-tight receiver, from which the air is exhausted, and then silicate of soda or other preserving or sealing fluid is caused to descend in a spray-like form upon the eggs, completely coating them.

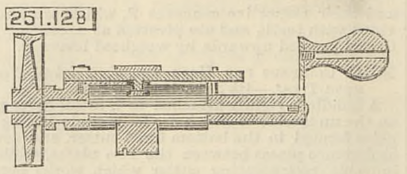
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

251,128. Magneto-signal Generator, *John B. Odell, Chicago, Ill.—Filed July 29th, 1881.*

Brief.—On the generator shaft are two collars, insulated from the shaft and from each other and in electrical connection with each pole of the generator

251.128

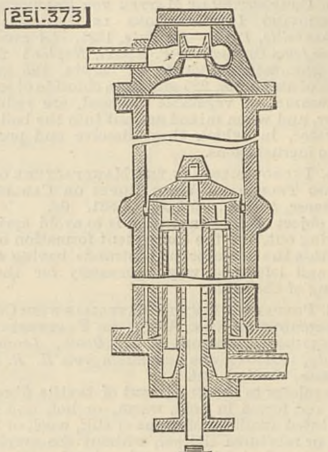


respectively. These collars are normally connected by a spring bar, and the generator thus short-circuited; but the turning of the crank moves said spring-bar into an insulated position, thereby breaking the short circuit.

251,373. Compressing Pump for Air, Gases, and Elastic Vapours, *Samuel D. Pount, Phœnix, Ariz.—Filed March 31st, 1881.*

Claim.—(1) A compressing pump consisting of an upright cylinder with a valve on the upper head, combined with an inverted cup-shaped piston placed within said cylinder and provided with a valve on the upper end and a packing-ring or its equivalent near the lower end, said piston being attached to and operated by a rod or its equivalent, and said packing-ring being at all times in contact with the interior of the cylinder, substantially as and for the purposes set forth. (2) The combination, within the upright cylinder of a compressing pump, of an inverted cup-shaped piston with a lubricating reservoir so constructed that the open end of the cup-shaped piston is

251.373

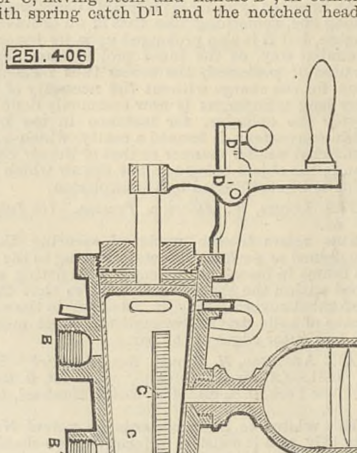


immersed in the lubricant at each stroke of the piston, and the lubricant is not allowed access to the compressed air or vapour, substantially as and for the purposes specified. (3) A compressing pump consisting of an upright cylinder, with a valve on the upper head, and an inverted cup-shaped piston within said cylinder, provided with a valve on the upper end and a packing-ring or its equivalent near the lower end, said piston being attached to and operated by a rod or its equivalent, in combination with a lubricating reservoir having a channel or channels through the same for the passage of the uncompressed air or vapour, substantially as and for the purposes set forth.

251,406. Oiler for Locomotives, *Alva O. Brooks and Philip A. Bowen, Milwaukee, Wis.—Filed October 1st, 1881.*

Claim.—(1) In combination with the cock having ports above and ports B B[1] below, the cylinder having ports and slots C[1], substantially as set forth. (2) The cylinder C, having stem and handle D[1], in combination with spring catch D[11] and the notched head of

251.406

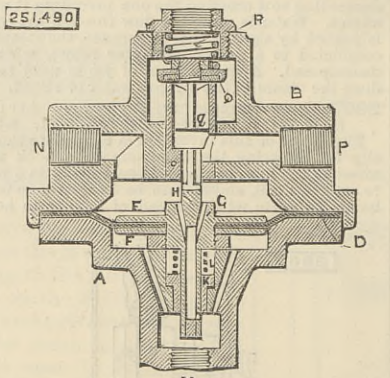


the cock, as set forth. (3) In an oiling device, a receptacle for the oil from the cup, having an outlet leading to the steam-chest, and a port connecting with a steam-pipe leading from the boiler, whereby live steam may be admitted to the oil receptacle to mix with and carry its contents out into the steam-chest, as set forth. (4) The process of oiling a steam-chest from an oil cock or receptacle by admitting steam directly from the boiler to the oil receptacle, and conducting the live steam and oil mixed into the steam-chest, as set forth.

251,490. Valve Arrangement for Pneumatic Railway Brakes, *George Westinghouse, jun., Pittsburg, Pa.—Filed August 27th, 1881.*

Claim.—(1) The combination, in one valve-box made in two parts A and B, and having the four nozzles M N P S, of the flexible diaphragm D, the bored stem G, having end passages and a lateral aperture, the stem H, partly cut away at the sides, the valve Q and its stem, the bushes K and O, the passages, and the springs L and R, substantially as and for the purposes

251.490



herein set forth. (2) The flexible diaphragm D, having a stem G, perforated or hollow through a part of its length, cylindrical, as at H, through another part, and recessed through another part, in combination with valve-case A B, having nozzles M N S and P, substantially as set forth, with reference to providing for the disuse of a vacuum apparatus when coupled up with a compressed air mechanism.

251,537. Dynamo-electric Machine, *Thomas A. Edison, Menlo Park, N.J.—Filed August 30th, 1881.*

Brief.—Improvement on Letters Patent No. 242,898, dated June 14, 1881. Two series of concentric insulated rings are substituted for the radial bars of the above patent for making connection between the bars of the armature. *Claim.*—(1) In a dynamo or

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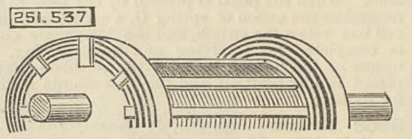
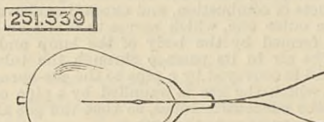


magneto-electric machine or electric engine having a cylindrical armature, the concentric rings for connecting the inductive bars, substantially as set forth. (2) In a dynamo or magneto-electric machine or electric engine, the combination, with the cylindrical armature core, of the longitudinal inductive bars, two series of concentric rings, and commutator-connections, substantially as set forth.

251,539. Electric Lamp, *Thomas A. Edison, Menlo Park, N.J., assignor to the Edison Electric Light Company, New York, N.Y.—Filed May 27th, 1881.*

Claim.—An incandescing electric lamp consisting of a glass bulb A, formed originally with an open lower

251.539

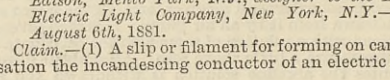


end having thickened walls, an incandescing conductor, and leading-in wires secured directly in the lower end of said bulb by the compression thereon of the thickened walls, substantially as shown.

251,540. Carbon for Electric Lamps, *Thomas A. Edison, Menlo Park, N.J., assignor to the Edison Electric Light Company, New York, N.Y.—Filed August 6th, 1881.*

Claim.—(1) A slip or filament for forming on carbonisation the incandescing conductor of an electric light,

251.540

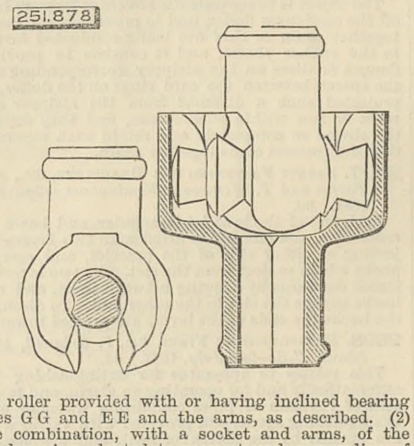


made of bamboo or similar fibre, substantially as set forth. (2) An incandescing carbon conductor for electric lights, made from cane, bamboo or similar fibre, substantially as set forth.

251,878. Shaft Coupling, *Calvin Q. Hayes, Sedalia, Mo.—Filed July 18th, 1881.*

Claim.—(1) The combination of the socket having projecting bearings or bearings in the projections with

251.878

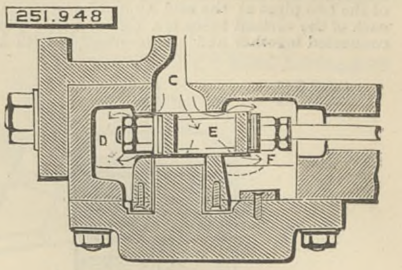


the roller provided with or having inclined bearing faces G G and E E and the arms, as described. (2) The combination, with a socket and arms, of the wooden pins adapted to prevent undue crowding of the parts, substantially as described. (3) The combination of the arms, the roller, and the wooden pin projecting inwardly, whereby the roller is retained in place when set up, substantially as described. (4) The combination, with the socket part of the coupling, of the sleeve A, provided with central perforation, and projections or stops B B, arranged in opposite corners, substantially as described.

251,948. Exhaust Valve for Steam Engines, *Chas. B. Richards, Philadelphia, Pa.—Filed November 7th, 1881.*

Claim.—(1) The combination of the exhaust port C and exhaust chest D of the cylinder of a steam engine with the reciprocating slide valve E, the pressure frame F, interposed between a chamber and the interior of the chest, and passages whereby a communication is opened at one time between the said chamber and the interior of the cylinder, and at another time between the cylinder, chamber, and exhaust chest, in obedience to the movement of the valve, all substantially as set forth. (2) The combination of the valve chest D, valve E, and pressure

251.948

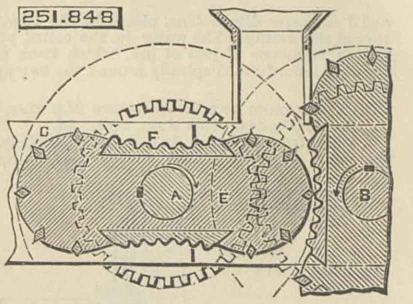


frame F with a block, extending into the opening of the said frame, substantially as specified.

251,848. Crushing and Grinding Machine, *George Duryee, Rahway, N.J.—Filed November 20th, 1880.—Renewed November 29th, 1881.*

Claim.—The combination of the shafts A B and grinding heads E E, the latter being constructed and arranged as herein described, and provided on their salient extremities with removable angular teeth G

251.848

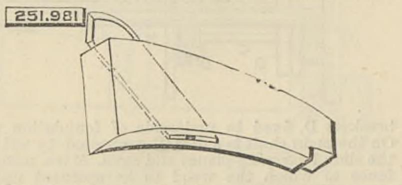


and on their concave surfaces with removable corrugated plates F, said teeth G being carried over the surfaces of the corrugated grinding plates F with a crushing and grinding action, as herein described and shown.

251,981. Cylinder and Concave Tooth for Thrashing Machines, *Henry P. White, Paw Paw, Mich.—Filed October 18th, 1881.*

Claim.—The combination, with a thrashing machine

251.981



cylinder or concave tooth, of a cutting blade secured thereto, substantially for the purpose herein set forth.

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The Engineer, February 17th, 1882.